Summit WM Series WLAN Switch and Altitude Access Point Software Version 4.1 Technical Reference Guide

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The following information is only included in the ExtremeXOS Command Reference Guide:

The ExtremeXOS operating system is based, in part, on the Linux operating system. The machine-readable copy of the corresponding source code is available for the cost of distribution. Please direct requests to Extreme Networks for more information at the following address:

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About this Guide

This guide describes how to install, configure, and manage the Summit® WM series switch, access points, and WLAN switch software.

Who should use this guide

This guide is a reference for system administrators who install and manage the Summit WM series switch, access points, and WLAN switch software system.

Any administrator performing tasks described in this guide must have an account with full administrative privileges.

What is in this guide

This guide contains the following chapters:

- About this Guide describes the target audience and content of the guide, the formatting conventions used in it, and how to provide feedback on the guide.
- Chapter 1 describes the configurations the Altitude access point (AP) uses to identify which Summit WM series switches are available to provide service in it's local area.
- Chapter 2 describes the capabilities of the Summit WM series switch that allow Altitude APs to periodically scan the RF space and report suspect devices.
- Chapter 3 provides the information necessary for the Deployment of Wireless Intranet Wireless.
- Chapter 4 provides recommendations and best practices for deploying an IEEE 802.11 WLAN in a large enterprise.
- Chapter 5 provides information about the Summit WM series switch diagnostics.
- Chapter 6 provides information about the Summit WM series switch hardware maintenance.
- Chapter 7 provides information on controlling access to the network resources for the wireless clients over the Summit WM series WLAN switch and Altitude AP software system.
- Chapter 8 provides information on FreeRADIUS options for RADIUS authentication and accounting.
- Chapter 9 provides a reference list of the RADIUS attributes that are supported by the Summit WM series switch, access points, and WLAN switch software.
- Chapter 10 provides a reference to the subset of MIB-II, as well as proprietary MIBs used in the repository of configuration and statistical data.
- Chapter 11 provides information about Dynamic Radio Management (DRM).
- Chapter 12 provides a reference list of the log and event messages.
- Chapter 13 provides a reference list of RFCs supported.
- Glossary provides a list of acronyms used throughout this document.

Formatting conventions

The Summit WM series switch, access points, and WLAN switch software documentation uses the following formatting conventions to make it easier to find information and follow procedures:

- **Bold** text is used to identify components of the management interface, such as menu items and section of pages, as well as the names of buttons and text boxes.

  For example: Click **Logout**.
- `Monospace` font is used in code examples and to indicate text that you type.

  For example: Type `https://<wm100-address>[:mgmt-port>]`
- The following symbols are used to draw your attention to additional information:

NOTE

Notes identify useful information that is not essential, such as reminders, tips, or other ways to perform a task.

WARNING!

Warnings identify essential information. Ignoring a warning can lead to problems with the application.

Documentation feedback

If you have any problems using this document, please contact your next level of support:

- Customers should contact the Extreme Networks Technical Assistance Center.

When you call, please have the following information ready. This will help us to identify the document that you are referring to.

- Title: Summit WM Series WLAN Switch and Altitude Access Point Software Version 4.1 Technical Reference Guide
- Part Number: 120370-00

Protocols and standards

Chapter 13, "Reference lists of standards" lists the protocols and standards supported by the Summit WM series switch, access points, and WLAN switch software. These lists include the Requests for Comment (RFCs) of the Internet Engineering Task Force (IETF) and the 802.11 standards developed by the Institute of Electrical and Electronics Engineers (IEEE).

1 Configuration of Dynamic Host Configuration Protocol (DHCP)

Altitude AP discovery supports the following methods:

- Service Location Protocol (SLP)
- Domain Name Server (DNS) – controller.<domainname>
- Multicast – Same subnet multicast discovery

The listed discovery methods are tried in succession until a method is identified which produces a successful registration with the a controller. Static configuration can also be used for Altitude AP registration. The static definition overrides any of the dynamic discovery methods.

For the Altitude AP's process to discover the Summit WM series switch, the Summit WM series switch, access points, and WLAN switch software system relies on a DHCP server that supports Option 78 and 79 for Service Location Protocol (SLP). The combination of Dynamic Host Configuration Protocol (DHCP), Option 78 and 79, and SLP provide a technique that defines the Summit WM series switch as the only element on the network that the Altitude AP can communicate with.

Option 78 is a list of IP addresses of Directory Agents, used by Service Agents and Users Agents.

Option 79 is an identifier that refers to a set of services called a scope. If a User Agent is assigned to a scope, it can only see the services in that scope, limiting the IP addresses of Directory Agents available to the User Agent.

SLP assisted Altitude AP registration includes the following:

- The Summit WM series switch Manager or the Altitude AP Manager use the Service Agent:
  - to look up the location of the Directory Agent using Option 78 and Option 79 in the DHCP server
  - to register with the Directory Agent
- The Altitude AP User Agent looks up the location of the Directory Agent using Option 78 and Option 79 in the DHCP server.
- The Altitude AP User Agent contacts the Directory Agent for services of the types "Extreme".
- The Altitude AP attempts to connect with the Summit WM series switch or Altitude AP Manager.

Through discovery the Altitude AP identifies which Summit WM series switchs are available in it's local area to provide service. The Altitude AP then registers with the Summit WM series switch using the CTP protocol, a proprietary UDP-based control, provisioning, and tunneling protocol.

NOTE

SLP may also be used for Inter-AC controller discovery, and in support of the Inter-AC mobility feature.

Service Location Protocol (SLP) (RFC2608)

Service Location Protocol (RFC2608) is a method of organizing and locating the resources (such as printers, disk drives, databases, e-mail directories, and schedulers) in a network. Using SLP, networking applications can discover the existence, location and configuration of networked devices.

In larger installations, services will register their services with one or more Directory Agents, and clients will contact the Directory Agent to fulfill requests for Service Location information.

Service Location Protocol consists of three cooperating services:

- **User Agent (UA)** – A process working on the user's behalf to acquire service attributes and configuration. The User Agent retrieves service information from the Service Agents or Directory Agents.
- **Service Agent (SA)** –A process working on the behalf of one or more services to advertise service attributes and configuration.
- **Directory Agent (DA)** – A process which collects information from Service Agents to provide a single repository of service information in order to centralize it for efficient access by User Agents. There can only be one DA present per given host.

When a service starts on the network, its Service Agent queries the DHCP server for Option 78 and Option 79 and registers itself appropriately.

DHCP Options for Service Location Protocol (RFC2610)

The Dynamic Host Configuration Protocol (RFC2131) provides a framework for passing configuration information to hosts on a TCP/IP network.

Entities using the Service Location Protocol, Version 2 (RFC2608) and Service Location Protocol, Version 1 (RFC2165) must obtain the address of Directory Agents in order to transact messages. The SLP Directory Agent option (Option 78) described in "SLP Directory Agent Option (Option 78)" on page 12 is used to configure User Agents and Service Agents with the location of Directory Agents in the network.

The SLP Scope Option (Option 79) described in "SLP Service Scope Option (Option 79)" on page 13provides an assignment of scope for configuration of SLP User and Service Agents. This option takes precedence over both default and static scope configuration of SLP agents. A scope is a set of services, typically making up a logical administrative group.

SLP Directory Agent Option (Option 78)

The SLP Directory Agent Option 78 specifies a list of IP addresses for SLP Directory Agents. Directory Agents should be listed in order of preference. Summit WM series switchs register themselves as directory agents.

The Length value must include one for the Mandatory byte and include four for each Directory Agent address which follows. The address of the Directory Agent is given in network byte order. The Mandatory byte in the Directory Agent option can be set to 0 or 1. If set to 1, the SLP User Agent or

Service Agent so configured must not employ either active or passive multicast discovery of Directory Agents.

The Directory Agents listed in Option 78 must be configured with the a non-empty subset of the scope list that the Agent receiving the Directory Agent Option 78 is configured with.

SLP Service Scope Option (Option 79)

Services are grouped together using scopes. Scopes are strings that identify a set of services that form an administrative grouping. Service Agents (SAs) and Directory Agents (DAs) are always assigned a scope string.

A User Agent (UA) is normally assigned a scope string (in which case the User Agent can only discover that particular grouping of services). This allows a network administrator to provision services to users. The use of scopes also allows the administrator to scale SLP deployments to larger networks.

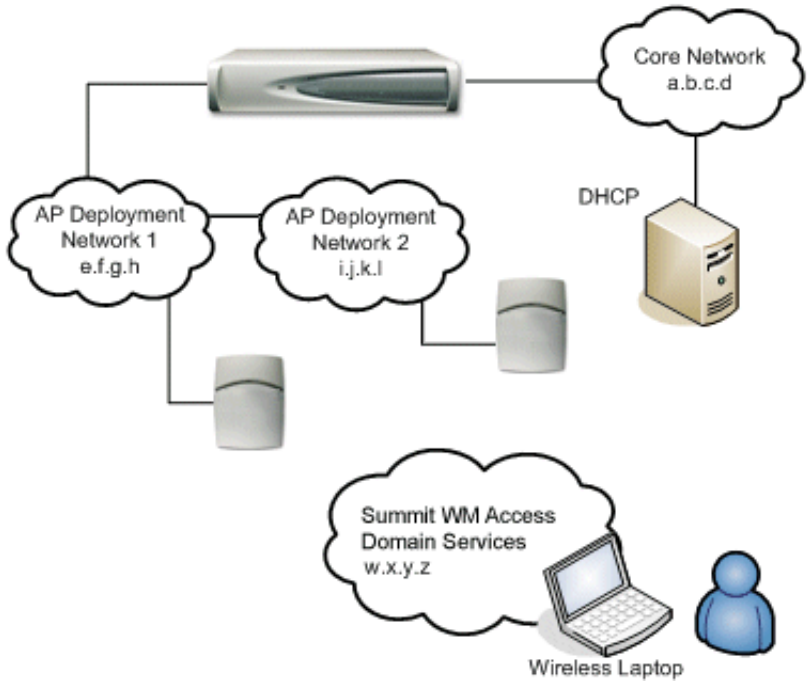
The Scope-List String is a comma-delimited list of the scopes that a SLP Agent is configured to use. The Length value must include one for the Mandatory byte. The Mandatory byte determines whether SLP Agents override their static configuration for scopes with the <Scope List> string provided by the option. This allows DHCP administrators to implement a policy of assigning a set of scopes to Agents for service provision.

If the Mandatory byte is 0, static configuration takes precedence over the DHCP provided scope list. If the Mandatory byte is 1, the <Scope List> provided in this option must be used by the SLP Agent. The Scope List String usage is defined in the SLPv2 specification (RFC2608).

Dynamic Host Configuration Protocol – Summit WM series switch and AP Discovery and other Services

Dynamic Host Configuration Protocol (DHCP) can be used for several purposes in a network configuration of a ***Summit WM Wireless LAN Switch setup. Consider the following diagram:

Figure 1: DHCP in a Summit WM system



This simple setup has the following properties:

- A Summit WM connected to a core network segment (a.b.c.d),
- APs connected on both direct (e.f.g.h) and indirect (i.j.k.l) subnets,
- An existing DHCP server somewhere in the core segment, and
- Wireless users connected to a Summit WM-controlled network (w.x.y.z).

In this setup there are four different areas in which DHCP must be considered:

Figure 2: Areas needing consideration for DHCP

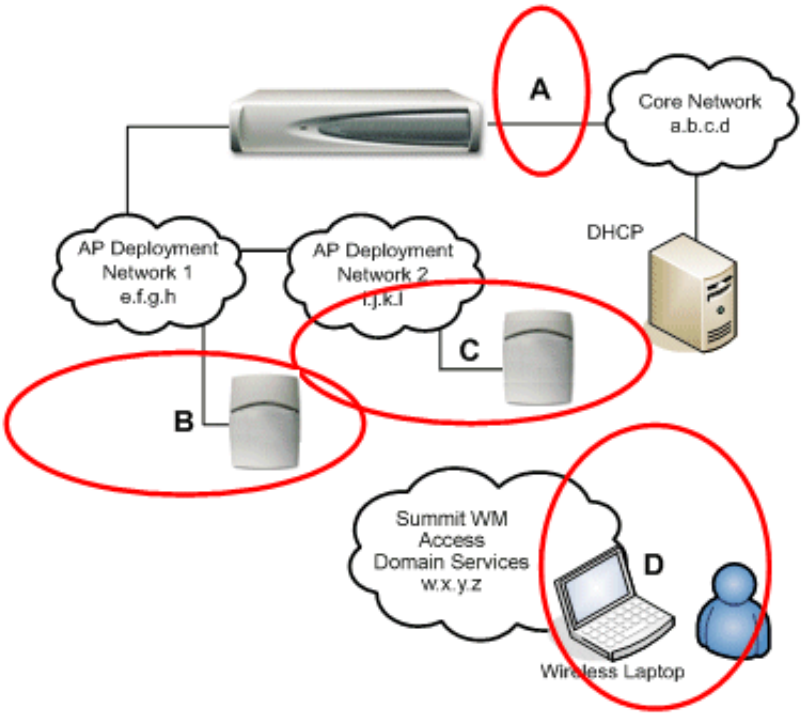


Table 1: Use of DHCP

Area	Description of use for DHCP
A	DHCP INFORM messages are periodically sent on all physical ports (esa0-1 on C1000, esa0-3 on C100). DHCP INFORM messages are NOT requests for addressing on that segment. These messages use DHCP INFORM option 78 to provide information to other Summit WMs deployed on the same segment. For setups that use multiple Summit WMs, a DHCP server in area A is required to answer requests for option 78 to allow availability and mobility to work. No addresses will be consumed. For a single Summit WM setup, a DHCP server in this area is not required. DHCP services for this area MUST be provided external to the Summit WM.
B	In general APs that are used with the Summit WM may use either a static or dynamically assigned IP address. For APs that are connected to the same subnet as the Summit WM initial discovery can take place directly using multicast. However, the deployer of the APs may still wish to utilize DHCP addressing for the APs. Additionally, support for option 78 may be used in this area to aid in the initial discovery of the Summit WM by the APs. DHCP services for this area MUST be provided external to the Summit WM.

Table 1: Use of DHCP (Continued)

Area	Description of use for DHCP
C	For AP deployment networks that are not in the same subnet as the Summit WM there needs to be some mechanism to allow the APs to find the Summit WM across subnet. The APs can use a static list of Summit WMs to connect to or use DNS but by far the most common method is to allow them to use DHCP option 78 to locate a service location protocol (SLP) director agent that is generally hosted on the Summit WM itself.
	In addition, the APs themselves may also be addressed via DHCP in this area.
	DHCP services for this area MUST be provided external to the Summit WM.
D	DHCP services in area D is for WLAN clients. A separate scope for each SSID is required.
	DHCP services for this area are provided by default by the Summit WM. DHCP services can also be relayed to an external DHCP server.

DHCP setup using the internal DHCP server

For simple DHCP setups it is recommended to use the Summit WM's built-in DHCP server. The internal DHCP server settings are available in the UI under WM-AD - Topology. This page allows for the configuration of the following options for DHCP:

Table 2: DHCP setup

Screen Item	Description
Gateway:	the Gateway of the network. This is give to the DHCP client as the 'routers' option.
Mask:	the netmask for the network
Address range:	the definition of a contiguous range using 'from:' and 'to:' fields
Exclusions:	the definition of multiple ranges or single addresses to exclude from the main range
Broadcast address:	the broadcast address for the network, automatically calculated
Domain name:	the domain name to hand out to the client. If the domain name is wireless.aDRM.com and the client hostname is laptop then the FQDN for the client using this network will be laptop.wireless.aDRM.com.
Lease default:	the default lease time in seconds. The default is 36000 (10 hours).
Lease max:	the maximum lease time in seconds. The default is 2592000 (30 days).
DNS servers:	a single or list of DNS servers to give the DHCP client. Use a comma to separate multiple entries on this line.
WINS:	a single or multiple WINS servers to give the DHCP client. Use a comma to separate multiple entries

The major benefit of using the internal DHCP server is that all DHCP messages from clients are logged and available in the GUI under Logs & Traces - DHCP messages.

For the inclusion of options that are not supported within this layout it is recommend to use DHCP relay.

DHCP setups for relayed WM-ADs and AP deployment networks

Sometimes it is necessary to use a DHCP server external from the Summit WM to give offer DHCP addresses. Popular reasons for this are:

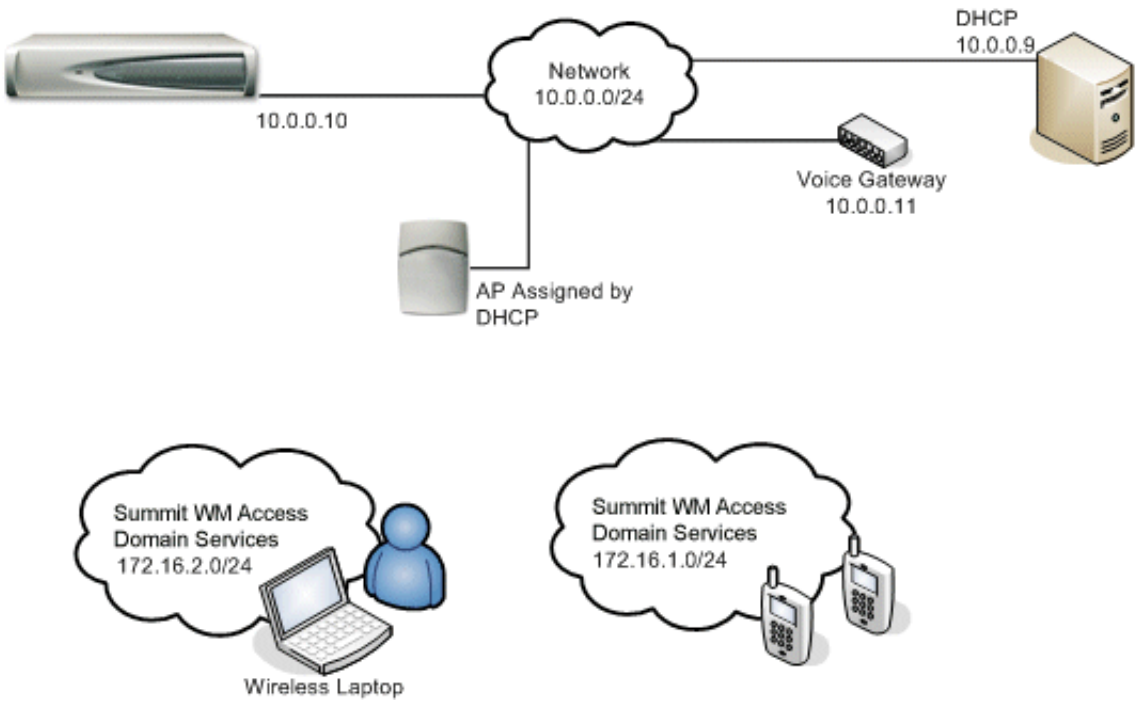
- Support for DHCP options that are not exposed through Summit WM GUI,
- To leverage existing DHCP infrastructures, and
- To consolidate the DHCP requirements for wireless client, APs, and the Summit WM in one place.

The one downfall of using DHCP relay comes in the logging of DHCP messages on the Summit WM. When using DHCP relay the DHCP log under Logs & Traces → DHCP Messages is not populated with DHCP requests. It is assumed that for DHCP relay that the target DHCP server has its own logging mechanism.

DHCP configuration example: OSC dhcpd on Linux

Consider the following topology:

Figure 3: Topology for DHCP example



The Summit WM is connected on network 10.0.0.0/24 as 10.0.0.10. Also on that network are a DHCP server, a voice gateway for phones, and all access points. The phones have the special property in that they require DHCP option 151 to find their voice gateway. Since the Summit WM-built-in DHCP server does not support custom options is was decided to use a Linux server at 10.0.09 to host all DHCP requirements for this network. It is possible to configure each WM Access Domain Service (WM-AD) to use DHCP relay to the example DHCP server of 10.0.0.9.

The following is the configuration file dhcpd.conf from the Linux server at 10.0.0.9:

Figure 4: dhcpd.conf example listing

```
1  authoritative;
2  ddns-update-style none;

3  option svp code 151 = ip-address ;

4  subnet 10.0.0.0 netmask 255.255.255.0 {
5        range 10.0.0.50 10.0.0.250;
6        option routers 10.0.0.10;
7        option slp-directory-agent true 10.0.0.10;
8  }

9  subnet 172.16.1.0 netmask 255.255.255.0 {
10       range 172.16.1.2 172.16.1.254;
11       option routers 172.16.1.1;
12       option domain-name "voice.company.com"
13       option domain-name-servers 10.0.0.9;
14       option svp 10.0.0.11;

15       default-lease-time 36000;
16       max-lease-time 2592000;
17       authoritative;
18 }

19 subnet 172.16.2.0 netmask 255.255.255.0 {
20       range 172.16.2.2 172.16.16.254;
21       option routers 172.22.246.1;
22       option domain-name "wlan.company.com"
23       option domain-name-servers 10.0.0.9;

24       default-lease-time 36000;
25       max-lease-time 2592000;
26       authoritative;
27 }
```

This file can be divided into the following four areas:

- General options: lines 1-3
- Scope for 10.0.0.0/24 subnet: lines 4-8
- Scope for 172.16.1.0/24 subnet (voice subnet): lines 9-18
- Scope for 172.16.2.0/24 subnet (laptop subnet): lines 19-27

General options

Line 1 designates this DHCP server as authoritative in case another DHCP server answers requests.

Line 2 sets options for Dynamic DNS. This option turns off DNS updates based upon DHCP mappings. There are other options that allow DHCP to update a DNS server to reflect the addresses handed out by the DHCP server. See the man page for dhcpd.conf for more information on support for this option.

Line 3 defines the format for DHCP option 151 as we want to use it. The phones being used on one of the wireless networks in this example require this option to find their voice gateway. Since the Summit WM does not allow for custom options this is the perfect place to insert this option.

Scope 10.0.0.0/24 (lines 4-8)

This scope is primarily defined to allow APs deployed in the same subnet to acquire an IP address. Also defined in this subnet is the option slp-directory-agent – this is option number 78 and allows the APs to find the Summit WM by Service Location Protocol. It also allows a multiple Summit WM setup that includes availability and mobility.

Notice that the static addresses in the topology use host addresses whose last octet is less than 50. The definition in the file specifically will address APs only from address 50-254 within this subnet. Thus, the static addresses used by the infrastructure elements are protected from use by the DHCP-enabled APs.

Scope 172.16.1.0/24 (lines 9-18)

This scope is defined to address wireless handsets. Notice the use of option 151 (now called ‘svp’ within the scope). Delivery of this option would be impossible from the Summit WM itself but it can be delivered through DHCP relay. The other options are self-explanatory.

Scope 172.16.2.0/24 (line 19-27)

This scope is defined to address general wireless devices using a separate SSID on the same system that the voice clients are deployed on. The options within this scope are very simple – see the dhcpd.conf and dhcpd-options man pages within Linux to review the variety of options that are available to be handed out to DHCP clients within your network.

Altitude Access Point Discovery mechanism

The following outlines an advanced version of our Altitude AP discovery mechanism. Note that this document only applies to the mechanism for discovering the IP address or addresses of the Summit WM series switch or set of Summit WM series switches that may provide service to a particular Altitude AP. It does not include a description of or make any assumptions about the mechanism to “connect” to a Summit WM series switch or of any failover scenarios for Summit WM series switch connection.

Altitude AP DHCP Registration Setup (WINDOWS)

You can configure the DHCP service that is included with Windows 2000 and Windows 2003 to provide DHCP option 78. Extreme Networks Altitude APs as clients to the Summit WM series switch may require the configuration of DHCP options 78 for controller discovery. These options are sometimes referred to as the SLP options. The SLP options (from Request for Comments [rfc] 2610) have an extra flag in the option field that is different than any other DHCP option. This flag is called the Mandatory byte. No other DHCP options for simple address arrays follow this structure.

The following example compares SLP options to DCHP options:

SLP options:

| Code = 78 | Length | Mandatory | a1 | a2 | a3 | a4 |...

All other DHCP options:

| Code = 32 | Length | a1 | a2 | a3 | a4 |...

This extra 5th byte prevents you from using the IPAddress array type in the snap-in when you add this option. However, you can add the option by creating option 78 as a Byte array.

Create a New DHCP Scope and Configure Option 78

1 Start Programs Administrative Tools DHCP

2 <Right mouse click> Server or Superscope (if created and applicable) select **New Scope.**

NOTE

If you wish to use an existing scope and all that you wish to do is add the SLP optioin; <right mouse click> on the Scope Options of the related existing DHCP scope and proceed to Step 13.

3 The New Scope Wizard will appear <Next>

4 Enter **Name** and **Description** of the new scope for the Altitude AP's <**Next**>

5 *IP Address Range dialog*; select the **Start** and **End** points for your Altitude AP IPs and the associated **Subnet** in one of two ways **Bit Length** (ex. 24) or **Dotted Decimal** (ex. 255.255.255.0) <**Next**>.

6 *Add Exclusions* dialog; If applicable **Start** and **End** points for addresses within the created pool that need to retain the same IP address. <**Next**>

7 *Lease Duration* dialog; Lease times <**Next**>

8 *Configure DHCP Options* dialog; Select **Yes** <**Next**>

9 *Default Gateway* dialog; Self explanatory <**Next**>

10 *Domain Information* dialog; Self explanatory <**Next**>

11 *WINS Information* dialog; Self explanatory <**Next**>

12 *Activate Scope* dialog; **Yes** <**Next**>

13 Under the newly created **Scope** <right mouse> on **Scope Options** select **Configure Options**

14 *General Tab*; Select Option 78 SLP DA (Service Location Protocol Directory Agent) then enter the Mandatory byte "00" and the IP address <in Hexadecimal> of the Summit WM series switch ESA Port that will host the Altitude APs (this will be the ESA port with the SLP Option selected).

NOTE

It is also possible to attend to this using Dotted Decimal form.

For example, for the controller ESA Port IP address 10.53.0.1, additions should be made in hexadecimal format **00** <lead byte> **0A 35 00 01** <IP address>

For the sake of convenience a quick reference chart follows for the decimal to hexidecimal conversions.

Table 3: Decimal to Hexidecimal Conversions

Dec-Hex	Dec-Hex	Dec-Hex	Dec-Hex	Dec-Hex	Dec-Hex	Dec-Hex	Dec-Hex	Dec-Hex
0 - 00	31-1F	62-3E	93-5D	124-7C	155-9B	186-BA	217-D9	248-F8
1 - 01	32-20	63-3F	94-5E	125-7D	156-9C	187-BB	218-DA	249-F9
2 - 02	33-21	64-40	95-5F	126-7E	157-9D	188-BC	219-DB	250-FA
3 - 03	34-22	65-41	96-60	127-7F	158-9E	189-BD	220-DC	251-FB
4 - 04	35-23	66-42	97-61	128-80	159-9F	190-BE	221-DD	252-FC
5 - 05	36-24	67-43	98-62	129-81	160-A0	191-BF	222-DE	253-FD
6 - 06	37-25	68-44	99-63	130-82	161-A1	192-C0	223-DF	254-FE
7 - 07	38-26	69-45	100-64	131-83	162-A2	193-C1	224-E0	255-FF
8 - 08	39-27	70-46	101-65	132-84	163-A3	194-C2	225-E1	
9 - 09	40-28	71-47	102-66	133-85	164-A4	195-C3	226-E2	
10-0A	41-29	72-48	103-67	134-86	165-A5	196-C4	227-E3	
11-0B	42-2A	73-49	104-68	135-87	166-A6	197-C5	228-E4	
12-0C	43-2B	74-4A	105-69	136-88	167-A7	198-C6	229-E5	
13-0D	44-2C	75-4B	106-6A	137-89	168-A8	199-C7	230-E6	
14-0E	45-2D	76-4C	107-6B	138-8A	169-A9	200-C8	231-E7	
15-0F	46-2E	77-4D	108-6C	139-8B	170-AA	201-C9	232-E8	
16-10	47-2F	78-4E	109-6D	140-8C	171-AB	202-CA	233-E9	
1711	48-30	79-4F	110-6E	141-8D	172AC	203-CB	234-EA	
18-12	49-31	80-50	111-6F	142-8E	173-AD	204-CC	235-EB	
19-13	50-32	81-51	112-70	143-8F	174-AE	205-CD	236-EC	
20-14	51-33	82-52	113-71	144-90	175-AF	206-CE	237ED	
21-15	52-34	83-53	114-72	145-91	176-B0	207-CF	238-EE	
22-16	53-35	84-54	115-73	146-92	177-B1	208-D0	239-EF	
23-17	54-36	85-55	116-74	147-93	178-B2	209-D1	240-F0	
24-18	55-37	86-56	117-75	148-94	179-B3	210-D2	241-F1	
25-19	56-38	87-57	118-76	149-95	180-B4	211-D3	242-F2	
26-1A	57-39	88-58	119-77	150-96	181-B5	212-D4	243-F3	
27-1B	58-3A	89-59	120-78	151-97	182-B6	213-D5	244-F4	
28-1C	59-3B	90-5A	121-79	152-98	183-B7	214-D6	245-F5	
29-1D	60-3C	91-5B	122-7A	153-99	184-B8	215-D7	246-F6	
30-1E	61-3D	92-5C	123-7B	154-9A	185-B9	216-D8	247-F7	

DNS Settings for Altitude AP Discovery

There is an assumption that for the use of this mechanism that there are DNS services configured and available.

1. Start Programs Administrative Tools DNS
2. <Right mouse click> Domain that will be used for discovery, select **New Host** (W2K Server) **New Host (A)** (W2003 server)
3. First field enter **Controller** which is the default name for the Summit WM series switch, then enter the **IP address of the HWC ESA port** that will host the Altitude AP connections.
4. Select **Create Pointer** <Finish>. This will create a pointer and **append the switch reference "Controller" to the existing domain string** to create the host record and in turn the "Forward Lookup" for the Altitude APs to discover the Summit WM series switch.

Static Altitude AP Addressing

The entry of static values is reliant on the fact that the Altitude AP has already discovered its DA(s) and is therefore registered or pending registration with the Summit WM series switch. Once this has taken place Static IP values can be configured for each Altitude AP in the **Static Configuration** tab of the **Wireless APs** option of the Summit WM series switch UI. If there are no DHCP SLP option enabled services then the IP(s) of the Summit WM series switch(es) should be included in the Wireless Controller Search List section of the "Static Configuration" tab of the "Wireless APs" option of the Summit WM series switch UI whether you are opting for Static or DHCP Altitude AP address assignment.

2 Rogue Access Point Detection

The Rogue AP detection feature provides capabilities to Summit WM series switches that allow Altitude APs to periodically scan the RF space and report suspect devices. With this capability, Altitude APs can multitask as scan devices as well as access points. This allows rogue detection to occur without installing expensive overlay sensor networks. The Summit WM series switch Rogue detection system is comprised of two major components; the Data Collector and the Analysis Engine.

The Data Collector runs on every Summit WM series switch and is responsible for initiating the rogue scans and compiling information received from all Altitude APs under its control.

The Analysis Engine is the brains of this function and runs on one Summit WM series switch in the network. It polls all Data Collectors periodically (default is every 5 seconds) and analyzes the polled data to identify new devices. It also uses the polled data to build a table of known "friendly" Altitude APs and 3rd Party Access Points. On subsequent scans, new devices are identified and compared to the "friendly" list and differences are flagged as potential Rogues. The Analysis Engine also includes a GUI to allow users to manually add or remove devices from the system or redefine a device identified as a potential rogue into a "friendly" if the proper designation of a device is determined.

An Altitude AP is assigned to a "scan group" that has a particular set of "scan parameters. Different groups can be defined so that the administrator can assign Altitude APs to logical groups to address either different geographic needs (that is, only scan certain buildings at certain times) or coverage issues (only scan with half of the Altitude APs in a given area at a given time). The algorithms and mechanisms for RF scanning have been designed to minimize the impact on user data. Also, a GUI is provided that provides the ability for an administrator to configure the frequency at which the Altitude APs within a scan group will initiate a scan (minimum 1 minute, and maximum 120 minutes)

Upon completion of the scan, the Altitude AP will send back the results to the Summit WM series switch and then wait for the next "scan interval" to repeat the process.

If a problem is found, an event is logged and an SNMP trap is generated indicating one of the following conditions has been identified:

1. Unknown AP with an invalid SSID – *Critical Alarm*
   a. A new device has been identified
2. Unknown AP with a valid SSID – *Critical Alarm*
   a. Someone may be trying to attract users by broadcasting a known SSID.
3. Known AP with an invalid SSID – *Critical Alarm*
   a. A Rogue may be spoofing a know MAC address.
4. Known Altitude AP with an invalid SSID– *Major Alarm*
   a. A Rogue may be spoofing a Altitude AP using a known MAC address.
5. Device that is in ad-hoc mode (IBSS) – *Major Alarm*
   a. A client configured in ad-hoc mode has been identified
6. Inactive Altitude AP with known SSID – *Major Alarm*
   a. A "known" Altitude AP has been detected that the Summit WM series switch has identified as not in service (stolen?)

7 Inactive Altitude AP with unknown SSID – *Major Alarm*

a A "known" Altitude AP with an unknown SSID has been detected that the Summit WM series switch has identified as not in service (stolen?)

With each event, the following information will be reported:

- Scanning Altitude AP Name & Scan Group
- Detection Date and Time
- Rogue SSID and Channel
- Signal Strength (RSSI)
- Security/Encoding type (for example. WEP, 802.1x, none, and so on)

This information is available through SNMP, or by viewing a report screen. In addition, a summary screen is provided as a pop-up window that provides a summary of all potential problem areas on a single screen.

NOTES: A Few Points Related to Summit WM series spy and Rogue Systems in General.

- In future releases the capabilities of the Summit WM series spy tool will be expanded to include graphic representation of the Rogue devices that are detected (rogue location will be plotted on imported floor plans or mapping).
- However, graphic plotting of a rogue device is not necessarily a "no-brainer" in terms of tracking down and dealing with rogues. The most common method used in graphic plotting is software driven calculations that approximate location based on RSSI values reported by multiple AP's finding the same rogue device (RSSI triangulation). The problem with this is that unless the rogue discovery tool uses very sophisticated algorithms and the AP / Rogue seek design was established during initial survey/setup (vs. post implementation) there are many factors that could compromise the accuracy (sometimes significantly). Things such as the way that building materials effect the RSSI values noted by APs in the same general area, Multipath, etc.
- Due the fact that accuracy is suspect an administrator will more than likely still have to hunt the rogue in person with a handheld/laptop to find the exact location. So, even using the just WM series spy information (mentally weigh and plot RSSI values from the scan group APs) an administrator can locate a rogue just as easily as with graphic tools.
- Some other systems address Rogues with a function known as "containment". Well this is a checkmark in terms of features there are some problems inherent to this capability that are due to the method of containment. Most containment is done via RF bombardment or via a ping DOS to the Rogue device. Unless WLAN gear uses very directional or phased array antenna systems this bombardment is not discriminating therefore effecting every device (MUs included) in close proximity. Also, if an Rogue containment AP is launching an attack (for containment) what is the service expectation of the client? Lastly, WiFi works in UNLICENSED spectrum, so what if the rogue that is detected is simply a neighboring WLAN with RF bleed into the scanned space. If a Rogue containment system attacks this, then it is attacking a co-existing legitimate system operating in open spectrum (the FCC and CRTC might have something to say about that), no one said that your WLAN neighbors have to keep their RF in their space.

3 Creating the Windows Security Infrastructure

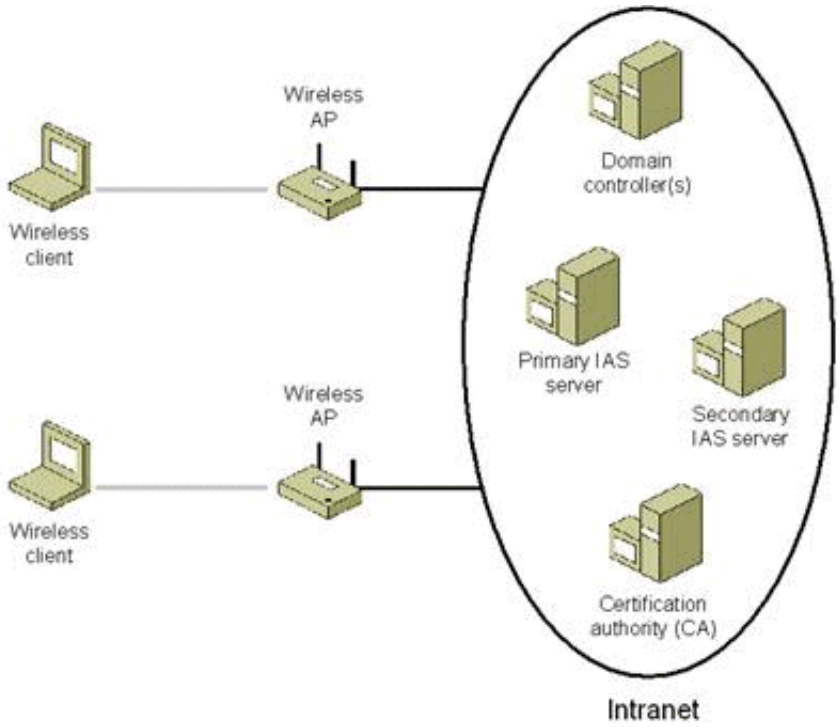
NOTE

To ensure information and best practice configuration integrity, all information contained in this section was extracted from two sources:
> "Deploying Secure 802.11 Wireless Networks with Microsoft Windows", by Joseph Davies
> http://www.microsoft.com/technet/prodtechnol/winxppro/deploy/ed80211.mspx

- Wireless client computers running Windows
  - Windows XP and Windows Server 2003 have built-in support for IEEE 802.11 wireless access and IEEE 802.1X authentication using the Extensible Authentication Protocol (EAP). Windows 2000 supports IEEE 802.1X authentication when either Windows 2000 Service Pack 4 (SP4) or Windows 2000 Service Pack 3 (SP3) and Microsoft 802.1X Authentication Client is installed (Windows 2000 SP4 is recommended).
- At least two Internet Authentication Service (IAS) servers.
  - At least two IAS servers (one primary and one secondary) are used to provide fault tolerance for Remote Authentication Dial-In User Service (RADIUS)-based authentication. If only one RADIUS server is configured and it becomes unavailable, wireless access clients cannot connect. By using two IAS servers and configuring all wireless access points (APs) (the RADIUS clients) for both the primary and secondary IAS servers, the RADIUS clients can detect when the primary RADIUS server is unavailable and automatically fail over to the secondary IAS server.
  - You can use either Windows Server 2003 or Windows 2000 Server IAS. IAS servers running Windows 2000 must have either SP4 or SP3 with Microsoft 802.1X Authentication Client installed (Windows 2000 SP4 is recommended). IAS is not included with Windows Server 2003, Web Edition
- Active Directory® directory service domains.
  - Active Directory domains contain the user accounts, computer accounts, and dial-in properties that each IAS server requires to authenticate credentials and evaluate authentication. While not a requirement, to both optimize IAS authentication and authentication response times and minimize network traffic, IAS should be installed on Active Directory domain controllers. You can use either Windows Server 2003 or Windows 2000 Server domain controllers. Windows 2000 domain controllers must have SP3 or SP4 installed.
- Computer certificates installed on the IAS servers.
  - Regardless of which wireless authentication method you use, you must install computer certificates on the IAS servers.
- For EAP-TLS authentication, a certificate infrastructure.
  - When the Extensible Authentication Protocol-Transport Level Security (EAP-TLS) authentication protocol is used with computer and user certificates on wireless clients, a certificate infrastructure, also known as a public key infrastructure (PKI), is needed to issue certificates
- For Protected EAP (PEAP) with Microsoft Challenge Handshake Authentication Protocol version 2 (MS-CHAP v2) authentication, root certification authority (CA) certificates on each wireless client. PEAP-MS-CHAP v2 is a password-based secure authentication method for wireless connections. Depending on the issuer of the IAS server computer certificates, you might also have to install root CA certificates on each wireless client.

- Wireless remote access policy.
  - A remote access policy is configured for wireless connections so that employees can access the organization intranet.
- Multiple wireless APs.
  - Multiple third-party wireless APs provide wireless access in different buildings of an enterprise. The wireless APs must support IEEE 802.1X, RADIUS, and Wi-Fi Protected Access (WPA™) or WPA2™. Wired Equivalent Privacy (WEP) is recommended only for temporary use when transitioning to WPA or WPA2.

Figure 5: Typical enterprise wireless configuration



Intranet Wireless Deployment Steps

For this configuration, complete the following steps:

- Step 1: Configuring the Certificate Infrastructure
- Step 2: Configuring Active Directory for Accounts and Groups
- Step 3: Configuring the Primary IAS Server
- Step 4: Configuring the secondary IAS server (if applicable)
- Step 5: Deploying and Configuring Wireless APs.
- Step 6: Configuring Wireless Network (IEEE 802.11) Policies Group Policy Settings
- Step 7: Installing Computer Certificates on Wireless Client Computers for EAP-TLS
- Step 8: Installing User Certificates on Wireless Client Computers for EAP-TLS
- Step 9: Configuring Wireless Clients for EAP-TLS
- Step 10: Configuring Wireless Client Computers for PEAP-MS-CHAP v2

Step 1: Configuring the Certificate Infrastructure

Table 4 summarizes the certificates needed for the different types of authentication.

Table 4: Authentication types and certificates

Authentication Type	Certificates on Wireless Client	Certificates on IAS Server
EAP-TLS	Computer certificates User certificates Root CA certificates for issuers of IAS server computer certificates	Computer certificates Root CA certificates for issuers of wireless client computer and user certificates
PEAP-MS-CHAP v2	Root CA certificates for issuers of IAS server computer certificates	Computer certificates

- Regardless of which authentication method you use for wireless connections, EAP-TLS or PEAP-MS-CHAP v2, you must install computer certificates on the IAS servers.
- For PEAP-MS-CHAP v2, you do not have to deploy a certificate infrastructure to issue computer and user certificates for each wireless client computer. Instead, you can obtain individual certificates for each IAS server in your enterprise from a commercial certification authority and install them on the IAS servers.
  - For more information, see "Step 3: Configuring the Primary IAS Server" and "Step 4: Configuring the Secondary IAS Server" in this article. Windows wireless clients include a number of root CA certificates for well known and trusted commercial CAs. If you obtain computer certificates from a commercial CA for which there is already an installed root CA certificate, there are no additional certificates to install on the Windows wireless clients.
  - If you obtain computer certificates from a commercial CA for which there is not already an installed root CA certificate, you must install the root CA certificates for the issuers of the computer certificates installed on the IAS servers on each Windows wireless client. For more information, see "Step 10: Configuring Wireless Client Computers for PEAP-MS-CHAP v2" in this article.
- For computer authentication with EAP-TLS, you must install a computer certificate, also known as a machine certificate, on the wireless client computer. A computer certificate installed on the wireless client computer is used to authenticate the wireless client computer so that the computer can obtain network connectivity to the enterprise intranet and computer configuration Group Policy updates prior to user login. For user authentication with EAP-TLS after a network connection is made and the user logs in, you must use a user certificate on the wireless client computer.
- The computer certificate is installed on the IAS server computer so that during EAP-TLS authentication, the IAS server has a certificate to send to the wireless client computer for mutual authentication, regardless of whether the wireless client computer authenticates with a computer certificate or a user certificate. The computer and user certificates submitted by the wireless client and IAS server during EAP-TLS authentication must conform to the requirements specified in "Using a Third-Party CA" in this article.
- In Windows Server 2003, Windows XP, and Windows 2000, you can view the certificate chain from the **Certification Path** tab in the properties of a certificate in the Certificates snap-in. You can view the installed root CA certificates in the Trusted Root Certification Authorities\Certificates folder and you can view the intermediate CA certificates in the Intermediate Certification Authorities\Certificates folder.
- In a typical enterprise deployment, the certificate infrastructure is configured using single root CA in a three-level hierarchy consisting of root CA/intermediate CAs/issuing CAs. Issuing CAs are configured to issue computer certificates or user certificates. When the computer or user certificate is

installed on the wireless client, the issuing CA certificate, intermediate CA certificates, and the root CA certificate is also installed. When the computer certificate is installed on the IAS server computer, the issuing CA certificate, intermediate CA certificates, and the root CA certificate is also installed. The issuing CA for the IAS server certificate can be different than the issuing CA for the wireless client certificates. In this case, both the wireless client and the IAS server computer have all the required certificates to perform certificate validation for EAP-TLS authentication.

Best Practices

- If you are using EAP-TLS authentication, use both user and computer certificates for both user and computer authentication.
- If you are using EAP-TLS authentication, do not also use PEAP-TLS. Allowing both protected and unprotected authentication traffic for the same type of network connection renders the protected authentication traffic susceptible to spoofing attacks.
- If you already have a certificate infrastructure for EAP-TLS authentication and are using RADIUS for dial-up or virtual private network (VPN) remote access connections, you can skip some of the certificate infrastructure steps. You can use the same certificate infrastructure for wireless connections. However, you must ensure that computer certificates are installed for computer authentication.
- For computers running Windows XP with no service packs installed, you must have user certificates stored on the computer for user authentication (rather than using smart cards).
- For computers running Windows Server 2003, Windows XP with Service Pack (SP1), Windows XP with Service Pack 2 (SP2), or Windows 2000, you can use either user certificates stored on the computer or a smart card for user authentication.

Step 1a: Installing a Certificate Infrastructure

When installing a certificate infrastructure, use the following best practices:

- Plan your public key infrastructure (PKI) before deploying CAs.
- The root CA should be offline and its signing key should be secured by a Hardware Security Module (HSM) and kept in a vault to minimize potential for key compromise.
- Enterprise organizations should not issue certificates to users or computers directly from the root CA, but rather should deploy the following:
  - An offline root CA
  - Offline intermediate CAs
  - Online issuing CAs (using Windows Server 2003 or Windows 2000 Certificate Services as an enterprise CA)
  - This CA hierarchy provides flexibility and insulates the root CA from attempts to compromise its private key by malicious users. The offline root and intermediate CAs do not have to be Windows Server 2003 or Windows 2000 CAs. Issuing CAs can be subordinates of a third party intermediate CA.
- Backing up the CA database, the CA certificate, and the CA keys is essential to protect against the loss of critical data. The CA should be backed up on a regular basis (daily, weekly, monthly) based on the number of certificates issued over the same interval. The more certificates issued, the more frequently you should back up the CA.
- You should review the concepts of security permissions and access control in Windows, since enterprise CAs issue certificates based on the security permissions of the certificate requester.

Additionally, if you want to take advantage of autoenrollment for computer certificates, use Windows 2000 or Windows Server 2003 Certificate Services and create an enterprise CA at the issuer CA level. If you want to take advantage of autoenrollment for user certificates, use Windows Server 2003, Enterprise Edition, or Windows Server 2003, Datacenter Edition, Certificate Services and create an enterprise CA at the issuer CA level.

By default, the IAS server checks for certificate revocation for all the certificates in the certificate chain sent by the wireless client during the EAP-TLS authentication process. If certificate revocation fails for any of the certificates in the chain, the connection attempt is not authenticated and is denied. The certificate revocation check for a certificate can fail because of the following:

- The certificate has been revoked, The issuer of the certificate has explicitly revoked the certificate.
- The certificate revocation list (CRL) for the certificate is not reachable or available.
  - CAs maintain CRLs and publish them to specific CRL distribution points. The CRL distribution points are included in the CRL Distribution Points property of the certificate. If the CRL distribution points cannot be contacted to check for certificate revocation, then the certificate revocation check fails.
  - Additionally, if there are no CRL distribution points in the certificate, the IAS server cannot verify that the certificate has not been revoked and the certificate revocation check fails.
- The publisher of the CRL did not issue the certificate.
- Included in the CRL is the publishing CA. If the publishing CA of the CRL does not match the issuing CA for the certificate for which certificate revocation is being checked, then the certificate revocation check fails.
- The CRL is not current
  - Each published CRL has a range of valid dates. If the CRL **Next update** date has passed, the CRL is considered invalid and the certificate revocation check fails. New CRLs should be published before the expiration date of the last published CRL

Because certificate revocation checking can prevent wireless access due to the unavailability or expiration of CRLs for each certificate in the certificate chain, design your PKI for high availability of CRLs. For instance, configure multiple CRL distribution points for each CA in the certificate hierarchy and configure publication schedules that ensure that the most current CRL is always available.

Certificate revocation checking is only as accurate as the last published CRL. For example, if a certificate is revoked, by default the new CRL containing the newly revoked certificate is not automatically published. CRLs are typically published based on a configurable schedule. This means that the revoked certificate can still be used to authenticate because the published CRL is not current; it does not contain the revoked certificate and can therefore still be used to create wireless connections. To prevent this from occurring, the network administrator must manually publish the new CRL with the newly revoked certificate.

By default the IAS server uses the CRL distribution points in the certificates. However, it is also possible to store a local copy of the CRL on the IAS server. In this case, the local CRL is used during certificate revocation checking. If a new CRL is manually published to the Active Directory, the local CRL on the IAS server is not updated. The local CRL is updated when it expires. This can create a situation wherein a certificate is revoked, the CRL is manually published, but the IAS server still allows the connection because the local CRL has not yet been updated.

Step 1b: Installing Computer Certificates

If you are using a Windows Server 2003 or Windows 2000 Certificate Services enterprise CA as an issuing CA, you can install a computer certificate on the IAS server by configuring Group Policy for the autoenrollment of computer certificates for computers in an Active Directory system container.

To configure computer certificate enrollment for an enterprise CA:

1. Open the Active Directory Users and Computers snap-in.
2. In the console tree, double-click **Active Directory Users and Computers**, right-click the domain name to which your CA belongs, and then click **Properties**
3. On the **Group Policy** tab, click the appropriate Group Policy object (the default object is **Default Domain Policy**), and then click **Edit**.
4. In the console tree, open **Computer Configuration**, then **Windows Settings**, then **Security Settings**, then **Public Key Policies**, then **Automatic Certificate Request Settings**.
5. Right-click **Automatic Certificate Request Settings**, point to **New**, and then click **Automatic Certificate Request**.
6. The Automatic Certificate Request wizard appears. Click **Next**.
7. In **Certificate templates**, click **Computer**, and then click **Next**. Your enterprise CA appears on the list
8. Click the enterprise CA, click **Next**, and then click **Finish**.
9. To immediately obtain a computer certificate for the CA that is running Windows 2000 Server, type the following at a command prompt: **secedit /refreshpolicy machine_policy**
10. To immediately obtain a computer certificate for the CA that is running Windows Server 2003, type the following at a command prompt: **gpupdate /target:computer**

After the domain is configured for autoenrollment, each computer that is a member of the domain requests a computer certificate when computer Group Policy is refreshed. By default, the Winlogon service polls for changes in Group Policy every 90 minutes. To force a refresh of computer Group Policy, restart the computer or type **secedit /refreshpolicy machine_policy** (for a computer running Windows 2000) or **gpupdate /target:computer** (for a computer running Windows XP or Windows Server 2003) at a command prompt. Perform this procedure for each domain system container as appropriate.

Best Practices

If you use a Windows Server 2003 or Windows 2000 enterprise CA as an issuing CA, configure autoenrollment of computer certificates to install computer certificates on all computers. Ensure that all appropriate domain system containers are configured for autoenrollment of computer certificates either through the inheriting of group policy settings of a parent system container or explicit configuration

Step 1c: Installing User Certificates

If you are using a Windows Server 2003, Enterprise Edition, or Windows Server 2003, Datacenter Edition, enterprise CA as an issuing CA, you can install user certificates through autoenrollment. Configuring user certificate autoenrollment for wireless user certificates requires you to duplicate existing certificate templates, a feature that is only supported for Windows Server 2003, Enterprise Edition, or Windows Server 2003, Datacenter Edition, enterprise CAs.

Only Windows XP and Windows Server 2003 wireless clients support user certificate autoenrollment.

To configure user certificate enrollment for a Windows Server 2003, Enterprise Edition, or Windows Server 2003, Datacenter Edition, enterprise CA:

1 Click **Start**, click **Run**, type **mmc**, and then click **OK**.

2 On the **File** menu, click **Add/Remove Snap-in**, and then click **Add**.

3 Under **Snap-in,** double-click **Certificate Templates**, click **Close**, and then click **OK**.

4 In the console tree, click **Certificate Templates**. All of the certificate templates will be displayed in the details pane.

5 In the details pane, click the **User** template.

6 On the **Action** menu, click **Duplicate Template**.

7 In the **Display Name** field, type **WirelessUser** (example name).

8 Make sure that the **Publish Certificate in Active Directory** check box is selected.

9 Click the **Security** tab.

10 In the **Group or user names** field, click **Domain Users**.

11 In the **Permissions for Domain Users** list, select the **Enroll** and **Autoenroll** permission check boxes and then click **OK**.

12 Open the Certification Authority snap-in.

13 In the console tree, open **Certification Authority**, then the CA name, then **Certificate Templates**.

14 On the **Action** menu, point to **New**, and then click **Certificate to Issue**.

15 Click **WirelessUser** (example) and click **OK**

16 Open the Active Directory Users and Computers snap-in.

17 In the console tree, double-click **Active Directory Users and Computers**, right-click the domain system container that contains the wireless user accounts, and then click **Properties**.

18 On the **Group Policy** tab, click the appropriate Group Policy object (the default object is **Default Domain Policy**), and then click **Edit**.

19 In the console tree, open **User Configuration**, then **Windows Settings**, then **Security Settings**, then **Public Key Policies**.

20 In the details pane, double-click **Autoenrollment Settings**

21 Click **Enroll certificates automatically**.

22 Select the **Renew expired certificates, update pending certificates, and remove revoked certificates** check box.

23 Select the **Update certificates that use certificate templates** check box and click **OK**

Perform steps 17-23 for each domain system container as appropriate.

Best Practices

If you use a Windows Server 2003, Enterprise Edition, or Windows Server 2003, Datacenter Edition, enterprise CA as an issuing CA, configure autoenrollment of user certificates to install user certificates on all computers. Ensure that all appropriate domain system containers are configured for autoenrollment of user certificates either through the inheriting of group policy settings of a parent system container or explicit configuration.

Step 2: Configuring Active Directory for Accounts and Groups

To configure Active Directory user and computer accounts and groups for wireless access, do the following:

1. If you are using Windows 2000 domain controllers, install Windows 2000 SP3 or SP4 on all domain controllers.
2. Ensure that all users that are making wireless connections have a corresponding user account.
3. Ensure that all computers that are making wireless connections have a corresponding computer account.
4. Set the remote access permission on user and computer accounts to the appropriate setting (either **Allow access** or **Control access through Remote Access Policy**). The remote access permission setting is on the **Dial-in** tab on the properties of a user or computer account in the Active Directory Users and Computers snap-in.
5. Organize your wireless access user and computer accounts into the appropriate groups. For a native-mode domain, you can use universal and nested global groups. For example, create a universal group named Wireless Users that contains global groups of wireless user and computer accounts for intranet access.

Best Practice

Use a native-mode domain and universal groups and global groups to organize your wireless accounts into a single group.

Step 3: Configuring the Primary IAS Server

Configuring the primary IAS server on a computer involves the following:

- Configuring IAS to be able to access account information, logging, UDP ports, and for the RADIUS clients corresponding to the wireless APs.
- Configuring a remote access policy for wireless access.

Step 3a: Configuring IAS

To configure the primary IAS server on a computer, do the following:

1. If you are using computer certificate autoenrollment and Windows 2000 IAS, force a refresh of computer Group Policy by typing **secedit /refreshpolicy machine_policy** from a command prompt. If you are using computer certificate autoenrollment and Windows Server 2003 IAS, force a refresh of computer Group Policy by typing **gpupdate /target:computer** from a command prompt.
2. If you are using PEAP-MS-CHAP v2 authentication and have obtained a computer certificate from a commercial CA, use the Certificates snap-in to import it into the Certificates (Local Computer)\Personal\Certificates folder. To perform this procedure, you must be a member of the Administrators group on the local computer, or you must have been delegated the appropriate authority. It is also possible to import a certificate by double-clicking a certificate file that is stored in

a folder or sent in an email message. Although this works for certificates created with Windows CAs, this method does not work for third-party CAs. The recommended method of importing certificates is to use the Certificates snap-in. For information about how to install a VeriSign, Inc. certificate for PEAP-MS-CHAP v2 authentication, see Obtaining and Installing a VeriSign WLAN Server Certificate for PEAP-MS-CHAP v2 Wireless Authentication.

3 Install IAS as an optional networking component.

4 If you are using Windows 2000 IAS, install Windows 2000 SP4.

5 The primary IAS server computer must be able to access account properties in the appropriate domains. If IAS is being installed on a domain controller, no additional configuration is required in order for IAS to access account properties in the domain of the domain controller. If IAS is not installed on a domain controller, you must configure the primary IAS server computer to read the properties of user accounts in the domain. For more information, see the "Enable the IAS server to read user accounts in Active Directory" procedure in this section. If the IAS server authenticates and authorizes wireless connection attempts for user accounts in other domains, verify that the other domains have a two-way trust with the domain in which the IAS server computer is a member. Next, configure the IAS server computer to read the properties of user accounts in other domains. For more information, see the "Enable the IAS server to read user objects in Active Directory" procedure in this section. If there are accounts in other domains, and those domains do not have a two-way trust with the domain in which the IAS server computer is a member, you must configure a RADIUS proxy between the two untrusted domains. If there are accounts in other Active Directory forests, you must configure a RADIUS proxy between the forests. For more information, see "Cross-Forest Authentication" in this article.

6 If you want to store authentication and accounting information for connection analysis and security investigation purposes, enable logging for accounting and authentication events. Windows 2000 IAS can log information to a local file. Windows Server 2003 IAS can log information to a local file and to a Structured Query Language (SQL) server database. For more information, see the topic titled "Configure log file properties" in Windows 2000 Help and the topic titled "Configure logging for user authentication and accounting" in Windows Server 2003 Help and Support.

7 If needed, configure additional UDP ports for authentication and accounting messages that are sent by RADIUS clients (the wireless APs). For more information, see the "Configure IAS port information" procedure in this section. By default, IAS uses UDP ports 1812 and 1645 for authentication messages and UDP ports 1813 and 1646 for accounting messages.

8 Add the wireless APs as RADIUS clients of the IAS server. For more information, see the "Add RADIUS clients" procedure in this section. Verify that you are configuring the correct name or IP address and shared secret for each wireless AP. Use a different shared secret for each wireless AP. Each shared secret should be a random sequence of upper and lowercase letters, numbers, and punctuation that is at least 22 characters long. To ensure randomness, use a random character generation program to create shared secrets to configure on the IAS server and the wireless AP. To ensure the maximum security for RADIUS messages, it is recommended that you use Internet Protocol security (IPsec) Encapsulating Security Payload (ESP) with certificate authentication to provide data confidentiality, data integrity, and data origin authentication for RADIUS traffic sent between the IAS servers and the wireless APs. Windows 2000 and Windows Server 2003 support IPsec. IPsec must also be supported by the wireless APs.

Enable the IAS server to read user accounts in Active Directory

To register the IAS server in the default domain using Internet Authentication Service:

1 Log on to the IAS server with an account that has domain administrator permissions.

2 Open the Internet Authentication Service snap-in.

3 Right-click Internet Authentication Service, and then click **Register Server in Active Directory**. When the **Register Internet Authentication Service in Active Directory** dialog box appears, click **OK**

Register the IAS server in the default domain using the netsh tool

1 Log on to the IAS server with an account that has domain administrator permissions.
2 Open a command prompt.
3 At the command prompt, type: netsh ras add registeredserver

To register the IAS server in the default domain using Active Directory Users and Computers:

1 Log on to the IAS server with an account that has domain administrator permissions.
2 Open the Active Directory Users and Computers snap-in.
3 In the console tree, click the **Users** folder in the appropriate domain.
4 In the details pane, right-click **RAS and IAS Servers**, and then click **Properties**.
5 In the **RAS and IAS Servers Properties** dialog box, on the **Members** tab, add the IAS server

Register the IAS server in another domain using Active Directory Users and Computers

1 Log on to the IAS server with an account that has domain administrator permissions.
2 Open the Active Directory Users and Computers snap-in.
3 In the console tree, click the **Users** folder in the appropriate domain.
4 In the details pane, right-click **RAS and IAS Servers**, and then click **Properties**.
5 In the **RAS and IAS Servers Properties** dialog box, on the **Members** tab, add each of the appropriate IAS servers.

Register the IAS server in another domain using the netsh tool

1 Log on to the IAS server with an account that has domain administrator permissions.
2 Open a command prompt.
3 At the command prompt, type: **netsh ras add registeredserver** Domain IASServer in which Domain is the DNS domain name of the domain and IASServer is the name of the IAS server computer.

Configure IAS port information

1 Open the Internet Authentication Service snap-in.
2 Right-click **Internet Authentication Service**, and then click **Properties**
3 For Windows 2000 IAS, click the **RADIUS** tab. For Windows Server 2003, click the **Ports** tab. Examine the settings for ports. If your RADIUS authentication and RADIUS accounting UDP ports differ from the default values provided (1812 and1645 for authentication and 1813 and1646 for accounting), in **Authentication** and **Accounting**, type your port settings. To use multiple ports for authentication or accounting requests, separate the ports with commas.

Add RADIUS clients

1 Open the Internet Authentication Service snap-in.

2 For Windows 2000 IAS, in the console tree, right-click **Clients**, and then click **New Client**. For Windows Server 2003 IAS, in the console tree, right-click **RADIUS Clients**, and then click **New RADIUS Client**.

3 In **Friendly name**, type a descriptive name.

4 In **Protocol**, click **RADIUS**, and then click **Next**.

5 In **Client address (IP or DNS)**, type the DNS name or IP address for the client. If you are using a DNS name, click **Verify**. In the **Resolve DNS Name** dialog box, click **Resolve**, and then select the IP address you want to associate with that name from **Search Results**.

6 If you are planning to use wireless AP-specific remote access policies for configuration purposes (for example, a remote access policy that contains vendor-specific attributes), click **Client Vendor**, and select the manufacturer's name. If you do not know the manufacturer or it is not in the list, click **RADIUS Standard**.

7 In **Shared secret**, type the shared secret for the client, and then type it again in **Confirm shared secret**.

8 Click **Finish**.

Best Practices

If possible, use IPsec ESP to provide data confidentiality for RADIUS traffic between the wireless AP and the IAS servers. Use at least 3DES encryption and, if possible, certificates for Internet Key Exchange (IKE) main mode authentication.

Use shared secrets that consist of a random sequence of upper and lower case letters, numbers, and punctuation at least 22 characters long and use a different shared secret for each wireless AP. If possible, use a random string-generating computer program to create the shared secret

Step 3b: Configuring a Wireless Remote Access Policy

To configure a wireless remote access policy for the primary IAS server, do the following:

1 For Windows 2000 IAS, create a new remote access policy for wireless intranet access with the following settings:

   a Policy name: Wireless access to intranet (example)

   b Conditions: NAS-Port-Type=Wireless-Other and Wireless-IEEE 802.11, Windows-Groups=WirelessUsers

   c Permissions: Select Grant remote access permission.

   d Profile, **Authentication** tab: If you are using EAP-TLS authentication, select **Extensible Authentication Protocol** and the **Smart Card or other Certificate** EAP type. Clear all other check boxes. If you have multiple computer certificates installed on the IAS server, click **Configure**, and then select the appropriate computer certificate. If the intended computer certificate is not displayed, then it does not support SChannel.

   If you are using PEAP-MS-CHAP v2 authentication, select **Extensible Authentication Protocol** and the **Protected EAP (PEAP)** EAP type, and then click **Configure**. In the **Protected EAP Properties** dialog box, select the appropriate computer certificate and ensure that **Secured password (EAP-MSCHAP v2)** is selected as the EAP type.

Profile, **Encryption** tab: Clear all other check boxes except the **Strongest** check box. This forces all wireless connections to use 128-bit encryption. The settings on the **Encryption** tab correspond to the MS-MPPE-Encryption-Policy and MS-MPPE-Encryption-Types RADIUS attributes and might be supported by the wireless AP. If these attributes are not supported, clear all the check boxes except **No encryption. For** more information, see the "Add a remote access policy" procedure in this section

2 For Windows Server 2003 IAS, use the New Remote Access Policy Wizard to create a common remote access policy with the following settings:

   a Policy name: Wireless access to intranet (example)

   b Access Method: Wireless

   c User or Group Access: Group with the Wireless Users group selected (example group name)

   d Authentication Methods: **Smart Card or other Certificate** type (for EAP-TLS) or **Protected EAP (PEAP)** type (for EAP-MS-CHAP v2)

3 If the wireless APs require vendor specific attributes (VSAs), you must add the VSAs to the remote access policy. For more information, see the "Configure vendor-specific attributes for a remote access policy" procedure in this section.

4 For Windows 2000 IAS, delete the default remote access policy named **Allow access if dial-in permission is enabled**. To delete a remote access policy, right-click the policy name in the Internet Authentication Service snap-in and click **Delete**

Best Practice

If you are managing the remote access permission of user and computer accounts on a per-account basis, use remote access policies that specify a connection type. If you are managing the remote access permission through the remote access policy, use remote access policies that specify a connection type and group. The recommended method is to manage remote access permission through the remote access policy.

Add a remote access policy

1 Open the Internet Authentication Service snap-in.

2 In the console tree, right-click **Remote Access Policies**, and then click **New Remote Access Policy**.

Configure vendor-specific attributes for a remote access policy

1 Open the Internet Authentication Service snap-in.

2 In the console tree, click **Remote Access Policies**.

3 In the details pane, double-click the policy for which you want to configure a vendor-specific attribute (VSA).

4 Click **Edit Profile**, click the **Advanced** tab, and then click **Add**.

5 Look at the list to see whether your vendor-specific attribute is already in the list of available RADIUS attributes. If it is, double-click it, and then configure it as specified in your wireless AP documentation.

6 If the vendor-specific attribute is not in the list of available RADIUS attributes, click the **Vendor-Specific** attribute, and then click **Add**.

7 In the **Multivalued Attribute Information** dialog box, click **Add**

8 Specify the vendor for your wireless AP. To specify the vendor by selecting the name from the list, click **Select from list**, and then select the vendor of the wireless AP for which you are configuring the VSA. If the vendor is not listed, specify the vendor by typing the vendor code.

9 To specify the vendor by typing the vendor code, click **Enter Vendor Code** and then type the vendor code in the space provided. See RFC 1007 for a list of SMI Network Management Private Enterprise Codes.

10 Specify whether the attribute conforms to the VSA format specified in RFC 2865. If you are not sure, see your wireless AP documentation.

11 If your attribute conforms, click **Yes**. **It conforms**, and then click **Configure Attribute**. In **Vendor-assigned attribute number**, type the number assigned to the attribute (this should be an integer from 0 to 255). In **Attribute format**, specify the format for the attribute, and then in **Attribute value**, type the value you are assigning to the attribute.

12 If the attribute does not conform, click **No. It does not conform**, and then click **Configure Attribute**. In **Hexadecimal attribute value**, type the value for the attribute.

Best Practice

Investigate whether the wireless APs need VSAs and configure them during the configuration of the remote access policy. If you configure the VSAs after you configure the wireless APs, you have to re-synchronize the configuration of the primary IAS server to the secondary IAS server.

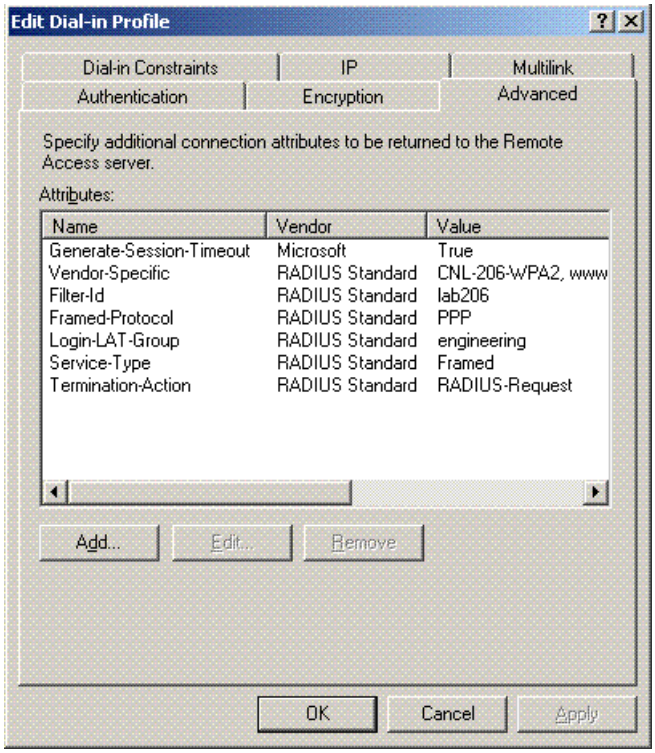
How to configure VSAs in the IAS server (Example)

1 Open Internet Authentication Service/Remote Access Policy.

2 Select the policy or create a new one. To create a new one:

- Right-click **Remote Access Policies**, and then select **New Remote Access Policy**. The **New Remote Access Policy** wizard is displayed.
- Follow the wizard steps to create a new policy.

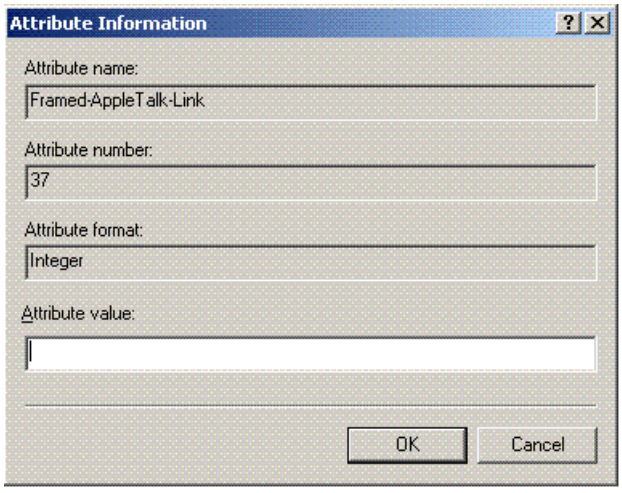
3 Click **Edit Profile**. The **Edit Dial-In Profile** dialog is displayed.



4 Click the **Advanced** tab.

5 Click **Add**. The **Add Attribute** dialog is displayed.

6 From the list, select the applicable Vendor Specific Attribute, and then click **Add**. The **Attribute Information** dialog is displayed.



7 In the **Attribute value** box, type `4329` as the vendor number, and then click **Ok**.

8 Configure the applicable attributes as per the dictionary file at: /etc/chantry/raddb/dictionary.extreme.

Dictionary file

File at /etc/chantry/raddb/dictionary.extreme the VSAs are:

```
# dictionary.extreme - Extreme Summit WM Wireless LAN Switch VSA dictionary

VENDOR          Extreme 4329
BEGIN-VENDOR Extreme
Standard Attribute
ATTRIBUTE       Extreme-URL-Redirection 1       string
ATTRIBUTE       Extreme-AP-Name         2       string
ATTRIBUTE       Extreme-AP-Serial       3       string
ATTRIBUTE       Extreme-WM-AD-Name      4       string
ATTRIBUTE       Extreme-SSID            5       string
ATTRIBUTE       Extreme-BSS-MAC         6       string
END-VENDOR      Extreme
```

Copy the file dictionary.extreme into the same directory where all the other vendor dictionaries are. Default is **/usr/local/share/freeradius/.**

Then edit the file **/usr/local/share/freeradius/dictionary** and add an include statement for **dictionary.extreme**. See extract below:

```
. . .
$INCLUDE dictionary.cabletron
$INCLUDE dictionary.cisco
$INCLUDE dictionary.extreme
#
```

Step 4: Configuring the secondary IAS server (if applicable)

To configure the secondary IAS server on another computer, do the following:

1. If you are using computer certificate autoenrollment and Windows 2000 IAS, force a refresh of computer Group Policy by typing **secedit /refreshpolicy machine_policy** from a command prompt. If you are using computer certificate autoenrollment and Windows Server 2003 IAS, force a refresh of computer Group Policy by typing **gpupdate /target:computer** from a command prompt.
2. If you are using PEAP-MS-CHAP v2 authentication and have obtained a computer certificate from a commercial CA, use the Certificates snap-in to import it into the Certificates (Local Computer)\ Personal\Certificates folder.
3. Install IAS as an optional networking component.
4. If you are using Windows 2000 IAS, install Windows 2000 SP4.
5. The secondary IAS server computer must be able to access account properties in the appropriate domains. If IAS is being installed on a domain controller, no additional configuration is required in order for IAS to access account properties in the domain of the domain controller.
   If IAS is not installed on a domain controller, you must configure the secondary IAS server computer to read the properties of user accounts in the domain. For more information, see the “Enable the IAS server to read user accounts in Active Directory” procedure previously described.
   If the secondary IAS server authenticates and authorizes connection attempts for user accounts in

other domains, verify that the other domains have a two-way trust with the domain in which the secondary IAS server computer is a member. Next, configure the secondary IAS server computer to read the properties of user accounts in other domains. For more information, see the "Enable the IAS server to read user objects in Active Directory" procedure previously described.
accounts in other domains, and those domains do not have a two-way trust with the domain in which the secondary IAS server computer is a member, you must configure a RADIUS proxy between the two untrusted domains. If there are accounts in other Active Directory forests, you must configure a RADIUS proxy between the forests. For more information, see "Cross-Forest Authentication" in this article.

6 To copy the configuration of the primary IAS server to the secondary IAS server, type **netsh aaaa show config >** *path\file.txt* at a command prompt on the primary IAS server. This stores the configuration settings, including registry settings, in a text file. The path can be relative, absolute, or a network path.

7 Copy the file created in step 7 to the secondary IAS server. At a command prompt on the secondary IAS server, type **netsh exec** *path\file.txt* . This command imports all the settings configured on the primary IAS server to the secondary IAS server.

NOTE

You cannot copy the IAS settings from an IAS server running Windows Server 2003 to an IAS server running Windows 2000 Server.

Best Practice

If you change the IAS server configuration in any way, use the Internet Authentication Service snap-in to change the configuration of the primary IAS server and then use steps 7 and 8 above to synchronize those changes on the secondary IAS server

Step 5: Deploying and Configuring Wireless APs

Deploy your wireless APs to provide coverage for all the areas of coverage for your wireless network. Configure your Summit WM series switch and Altitude APs to support WPA, WPA2, or WEP encryption with 802.1X authentication. Additionally, configure RADIUS settings on your Summit WM series switch with the following:

1 The IP address or name of a primary RADIUS server, the shared secret, UDP ports for authentication and accounting, and failure detection settings.

2 The IP address or name of a secondary RADIUS server, the shared secret, UDP ports for authentication and accounting, and failure detection settings.

To balance the load of RADIUS traffic between the two IAS servers, configure half of the wireless APs with the primary IAS server as the primary RADIUS server and the secondary IAS server as the secondary RADIUS server and the other half of the wireless APs with the secondary IAS server as the primary RADIUS server and the primary IAS server as the secondary RADIUS server.

If the wireless APs require vendor specific attributes (VSAs), you must add the VSAs to the remote access policies of the IAS servers. For more information, see the "Configure vendor-specific attributes for a remote access policy" procedure previously described. If you add VSAs to the remote access policy on the primary IAS server, perform steps 7 and 8 of the "Step 4: Configuring the secondary IAS server" section to copy the primary IAS server configuration to the secondary IAS server.

Step 6: Configuring Wireless Network (IEEE 802.11) Policies Group Policy Settings

With the Wireless Network (IEEE 802.11) Policies Group Policy extension provided in Windows Server 2003, you can specify a list of preferred networks and their settings to automatically configure wireless LAN settings for wireless clients running Windows XP with SP1, Windows XP with SP2, Windows Server 2003 with no service packs installed, or Windows Server 2003. For each preferred network, you can specify association settings (such as the SSID and the authentication and encryption method) and 802.1X authentication settings (such as the specific EAP type).

To configure Wireless Network (IEEE 802.11) Policies Group Policy settings, do the following:

1. Open the Active Directory Users and Computers snap-in
2. In the console tree, double-click **Active Directory Users and Computers**, right-click the domain system container that contains your wireless computer accounts, and then click **Properties**.
3. On the **Group Policy** tab, click the appropriate Group Policy object (the default object is **Default Domain Policy**), and then click **Edit**.
4. In the console tree, open **Computer Configuration**, then **Windows Settings**, then **Security Settings**, then **Wireless Network (IEEE 802.11) Policies**.
5. Right-click **Wireless Network (IEEE 802.11) Policies**, and then click **Create Wireless Network Policy**. In the Wireless Network Policy Wizard, type a name and description.
6. In the details pane, double-click your newly created wireless network policy.
7. Change settings on the **General** tab as needed.
8. Click the **Preferred Networks** tab. Click **Add** to add a preferred network.
9. On the **Network Properties** tab, type the wireless network name (SSID) and change wireless network key settings as needed.
10. Click the **IEEE 802.1x** tab. Change 802.1X settings as needed, including specifying and configuring the correct EAP type. Click **OK** twice to save changes.

The next time your Windows XP with SP1, Windows XP with SP2, and Windows Server 2003 wireless clients update computer configuration Group Policy, their wireless network configuration will be automatically configured.

NOTE

The version of the Wireless Network (IEEE 802.11) Policies Group Policy extension in Windows Server 2003 with no service packs installed does not support the configuration of Wi-Fi Protected Access (WPA) authentication and encryption settings for WPA-capable Windows wireless client computers (running Windows XP with SP1 and the WPA Wireless Security Update in Windows XP, Windows XP with SP2, or Windows Server 2003 with SP1). However, support for WPA settings configured through the Wireless Network (IEEE 802.11) Policies Group Policy extension has been added to Windows Server 2003 with either the 811233 update or SP1.

To get the new Wireless Network (IEEE 802.11) Policies Group Policy extension in a Windows 2000 Active Directory domain, the Active Directory schema must be updated to include the new extension. To update the Windows 2000 Active Directory schema, you must install at least one domain controller in your Windows 2000 Active Directory domain that runs either Windows Server 2003 with no service packs installed or Windows Server 2003 with SP1 (for WPA authentication and encryption settings). Once this is complete, you must use the Group Policy snap-in from any domain member computer

running either Windows Server 2003 with no service packs installed or Windows Server 2003 with SP1 to configure Wireless Network (IEEE 802.11) Policies settings.

NOTE

The Wireless Network (IEEE 802.11) Policies Group Policy extension for Windows Server 2003 with SP1 does not support the configuration of WPA2 authentication settings.

Step 7: Installing Computer Certificates on Wireless Client Computers for EAP-TLS

For computer authentication with EAP-TLS, you must install a computer certificate on the wireless client computer.

To install a computer certificate on a wireless client computer running Windows Server 2003, Windows XP, or Windows 2000, connect to the organization intranet using an Ethernet port and do the following:

- If the domain is configured for autoenrollment of computer certificates, each computer that is a member of the domain requests a computer certificate when computer Group Policy is refreshed. To force a refresh of computer Group Policy for a computer running Windows Server 2003 or Windows XP, restart the computer or type **gpupdate /target:computer** at a command prompt. To force a refresh of computer Group Policy for a computer running Windows 2000, restart the computer or type **secedit /refreshpolicy machine_policy** at a command prompt.
- If the domain is not configured for autoenrollment, you can request a "Computer" certificate using the Certificates snap-in or you can execute a CAPICOM script to install a computer certificate.

The enterprise organization's information technology (IT) group can install a computer certificate before the computer, typically a laptop, is delivered to its user.

For information about CAPICOM, search for "CAPICOM" at http://msdn.microsoft.com/.

Step 8: Installing User Certificates on Wireless Client Computers for EAP-TLS

For user authentication with EAP-TLS, you must use a locally installed user certificate or a smart card. The locally installed user certificate must be obtained through autoenrollment, Web enrollment, by requesting the certificate using the Certificates snap-in, by importing a certificate file, or by running a CAPICOM program or script.

The easiest methods of installing user certificates assume that network connectivity already exists, such as using an Ethernet port. When the user connects to the intranet, they can obtain a user certificate through autoenrollment or by submitting a user certificate request using Web enrollment or the Certificate Manager. For more information about requesting a user certificate, see the "Submit a user certificate request via the Web" and "Request a certificate" procedures in this section.

Alternately, the user can run a CAPICOM program or script provided by the network administrator. The execution of the CAPICOM program or script can be automated through the user logon script.

If you have configured autoenrollment of user certificates, then the wireless user must update User Configuration Group Policy to obtain a user certificate.

If you are not using autoenrollment for user certificates, use one of the following procedures to obtain a user certificate.

Submit a user certificate request via the Web

1 Open Internet Explorer.

2 In Internet Explorer, connect to http://servername/certsrv, where *servername* is the name of the Windows 2000 Web server where the CA you want to access is located.

3 Click **Request a certificate**, and then click **Next**.

4 On the **Choose Request Type** Web page, under **User certificate request**, select the type of certificate you want to request, and click **Next**.

5 Do one of the following from the **Identifying Information** Web page: If you see the message "All the necessary identifying information has already been collected. You may now submit your request," click **Submit**. Enter your identifying information for the certificate request, and click **Submit**.

6 If you see the **Certificate Issued** Web page, click **Install this certificate**

7 Close Internet Explorer

Request a certificate

1 Open an MMC console that contains **Certificates – Current User**.

2 In the console tree, right-click **Personal**, then point to **All Tasks**, and then click **Request New Certificate** to start the Certificate Request wizard.

3 In the Certificate Request Wizard, select the following information: The type of certificate you want to request. If you have selected the **Advanced** check box:

   a The cryptographic service provider (CSP) you are using.

   b The key length (measured in bits) of the public key associated with the certificate.

   c Do not enable strong private key protection.

   d If you have more than one CA available, select the name of the CA that will issue the certificate.

4 Type a friendly name for your new certificate

5 After the Certificate Request Wizard has successfully finished, click **OK**

Floppy Disk-Based Installation

Another method of installing a user certificate is to export the user certificate onto a floppy disk and import it from the floppy disk onto the wireless client computer. For a floppy disk-based enrollment, perform the following:

1 Obtain a user certificate for the wireless client's user account from the CA through Web-based enrollment. For more information, see the "Submit a user certificate request via the Web" procedure previously described.

2 Export the user certificate of the wireless client's user account to a .pfx file. For more information, see the "Export a certificate" procedure in this section. Within the Certificate Manager Export

wizard, export the private key and select **Delete the private key if the import is successful**. Save this file to a floppy disk and deliver it to the user of the wireless client computer.

3 On the wireless client computer, import the user certificate. For more information, see the "Import a certificate" procedure in this section.

Export a certificate

1 Open an MMC console containing **Certificates - Current User**.

2 Open **Personal**, and then open **Certificates**

3 In the details pane, right-click the certificate you want to export, point to **All Tasks**, and then click **Export**.

4 In the Certificate Export Wizard, click **Yes, export the private key**. (This option will appear only if the private key is marked as exportable and you have access to the private key.) Click **Next**.

5 Select **Personal Information Exchange – PKCS (.PFX)** as the export file format and click **Next**.

6 On the **Password** page, type a password in **Password** and **Confirm password** to protect the private key in the certificate and then click **Next**.

7 On the **File to Export** page, type the certificate filename or click **Browse** to specify the name and location of the certificate file. Click **Next**.

8 On the **Completing the Certificate Export Wizard** page, click **Finish**

Import a certificate

1 Open an MMC console containing **Certificates - Current User**

2 Open **Personal**, and then open **Certificates**.

3 In the details pane, right-click the certificate you want to export, point to **All Tasks**, and then click **Import**.

4 Type the file name containing the certificate to be imported. (You can also click **Browse** and navigate to the file.)

5 If it is a PKCS #12 file, do the following: Type the password used to encrypt the private key. (Optional) If you want to be able to use strong private key protection, select the **Enable strong private key protection** check box. (Optional) If you want to back up or transport your keys at a later time, select the **Mark key as exportable** check box.

6 Do one of the following: If the certificate should be automatically placed in a certificate store based on the type of certificate, select **Automatically select the certificate store based on the type of certificate**.

7 If you want to specify where the certificate is stored, select **Place all certificates in the following store**, click **Browse**, and select the certificate store to use.

Step 9: Configuring Wireless Clients for EAP-TLS

If you have configured Wireless Network (IEEE 802.11) Policies Group Policy settings and specified the use of EAP-TLS authentication (the **Smart Card or other Certificate** EAP type) for your wireless network, then no other configuration is needed for wireless clients running Windows XP with SP1, Windows XP with SP2, or Windows Server 2003.

To manually configure EAP-TLS authentication on a wireless client running Windows XP with SP1, Windows XP with SP2, or Windows Server 2003, do the following:

1 Obtain properties of the wireless connection in the Network Connections folder. Click the **Wireless Networks** tab, then click the name of the wireless network in the list of preferred networks and click **Properties**.

2 Click the Authentication tab and select Enable network access control using IEEE 802.1X and the Smart Card or other Certificate EAP type. This is enabled by default.

3 Click Properties. In the properties of the Smart Card or other Certificate EAP type, select Use a certificate on this computer to use a registry-based user certificate or Use my smart card for a smart card-based user certificate. If you want to validate the computer certificate of the IAS server, select **Validate server certificate** (enabled by default). If you want to specify the names of the authentication servers that must perform validation, select **Connect to these servers** and type the names.

4 Click **OK** to save changes to the Smart Card or other Certificate EAP type

To configure EAP-TLS authentication on a wireless client running Windows XP with no service packs installed, do the following:

1 Obtain properties of the wireless connection in the Network Connections folder. Click the **Authentication** tab, and then select **Enable network access control using IEEE 802.1X** and the **Smart Card or other Certificate** EAP type. This is enabled by default.

2 Click **Properties**. In the properties of the **Smart Card or other Certificate** EAP type, select **Use a certificate on this computer**. If you want to validate the computer certificate of the IAS server, select **Validate server certificate** (enabled by default). If you want to ensure that the server's DNS name ends in a specific string, select **Connect only if server name ends with** and type the string. For typical deployments where more than one IAS server is used, type the part of the DNS name that is common to all of the IAS servers. For example, if you have two IAS servers named IAS1.example.microsoft.com and IAS2.example.microsoft.com, then type the string "example.microsoft.com". Ensure that you type the correct string, otherwise, authentication will fail.

3 Click **OK** to save changes to the Smart Card or other Certificate EAP type

To configure EAP-TLS authentication on a wireless client running Windows 2000 SP4, do the following:

1 Obtain properties of the wireless connection in the Dial-up and Network Connections folder. Click the **Authentication** tab, and then select **Enable network access control using IEEE 802.1X** and the **Smart Card or other Certificate** EAP type. This is enabled by default.

2 Click **Properties**. In the properties of the **Smart Card or other Certificate** EAP type, select **Use a certificate on this computer** to use a registry-based user certificate or **Use my smart card** for a smart card-based user certificate. If you want to validate the computer certificate of the IAS server, select **Validate server certificate** (enabled by default). If you want to specify the names of the authentication servers that must perform validation, select **Connect to these servers** and type the names.

3 Click **OK** to save changes to the Smart Card or other Certificate EAP type

Step 10: Configuring Wireless Client Computers for PEAP-MS-CHAP v2

If you have configured Wireless Network (IEEE 802.11) Policies Group Policy settings and specified the use of PEAP-MS-CHAP v2 authentication for your wireless network (the **Protected EAP (PEAP)** type with the **Secured password (EAP-MSCHAP v2)** authentication method), then no other configuration for wireless clients running Windows XP with SP1, Windows XP with SP2, or Windows Server 2003 is needed.

To manually configure PEAP-MS-CHAP v2 authentication on a wireless client running Windows XP with SP1, Windows XP with SP2, or Windows Server 2003, do the following:

1. Obtain properties of the wireless connection in the Network Connections folder. Click the **Wireless Networks** tab, click the name of the wireless network in the list of preferred networks, and then click **Properties**.
2. Click the **Authentication** tab and select **Enable network access control using IEEE 802.1X** and the **Protected EAP** EAP type.
3. Click **Properties**. In the **Protected EAP Properties** dialog box, select **Validate server certificate** to validate the computer certificate of the IAS server (enabled by default). If you want to specify the names of the authentication servers that must perform validation, select **Connect to these servers** and type the names. In **Select Authentication Method**, click **Secured password (EAP-MSCHAP v2)**.

To configure PEAP-MS-CHAP v2 authentication on a wireless client running Windows 2000 SP4, do the following:

1. Obtain properties of the wireless connection in the Dial-up and Network Connections folder.
2. Click the Authentication tab and select Enable network access control using IEEE 802.1X and the Protected EAP EAP type.
3. Click Properties. In the Protected EAP Properties dialog box, select Validate server certificate to validate the computer certificate of the IAS server (enabled by default). If you want to specify the names of the authentication servers that must perform validation, select Connect to these servers and type the names. In Select Authentication Method, click Secured password (EAP-MSCHAP v2).

NOTE

By default, the PEAP-MS-CHAP v2 authentication uses your Windows logon credentials for wireless authentication. If you are connecting to a wireless network that uses PEAP-MS-CHAP v2 and you want to specify different credentials, click ***Configure*** *and clear the* ***Automatically use my Windows logon name and password*** *check box.*

Although the **Protected EAP Properties** dialog box for Windows XP with SP1, Windows XP with SP2, Windows Server 2003, and Windows 2000 SP4 has an **Enable Fast Reconnect** check box, IAS in Windows 2000 does not support fast reconnect. IAS in Windows Server 2003 does support fast reconnect.

If the root CA certificate of the issuer of the computer certificates installed on the IAS servers is already installed as a root CA certificate on your wireless clients, no other configuration is necessary. If your issuing CA is a Windows 2000 Server or Windows Server 2003 online root enterprise CA, then the root CA certificate is automatically installed on each domain member through computer configuration Group Policy.

To verify, obtain the properties of the computer certificate on the IAS server using the Certificates snap-in and view the certificate chain from the **Certification Path** tab. The certificate at the top of the path is the root CA certificate. Use the Certificates snap-in of a wireless client for each Windows operating system to ensure that this certificate is in the list of trusted root certification authorities in the Certificates (Local Computer)\Trusted Root Certification Authorities\Certificates folder.

If it is not, you must install the root CA certificate(s) of the issuer(s) of the computer certificates of the IAS servers on each wireless client for the Windows operating systems that do not contain them.

The easiest way to install a root CA certificate on all your wireless clients is to do the following:

1. Using the Certificates snap-in on an IAS server, export the root CA certificate of the issuing CA of computer certificates on the IAS servers to a file (*.PB7). You can find the root CA certificate in the Certificates (Local Computer)\Trusted Root Certification Authorities\Certificates folder.
2. Open the Active Directory Users and Computers snap-in.
3. In the console tree, double-click **Active Directory Users and Computers**, right-click the appropriate domain system container, and then click **Properties**.
4. On the **Group Policy** tab, click the appropriate Group Policy object (the default object is **Default Domain Policy**), and then click **Edit**.
5. In the console tree, open **Computer Configuration**, then **Windows Settings**, then **Security Settings**, and then **Public Key Policies.**
6. Right-click **Trusted Root Certification Authorities**, and then click **Import**
7. In the Certificate Import Wizard, specify the file that was saved in Step 1
8. Repeat steps 3-7 for all appropriate system containers

The next time the wireless client computers update their computer configuration Group Policy, the root CA certificate of the issuing CA of computer certificates on the IAS servers is installed in their local computer certificate store.

Alternately, you can use the Certificates snap-in to import the root CA certificates to the Certificates (Local Computer)\Trusted Root Certification Authorities\Certificates folder on each wireless client computer.

Additional Intranet Wireless Deployment Configurations

The section describes the following additional intranet wireless deployment configurations:

- Internet access for business partners
- Using a third-party CA
- Cross-forest authentication
- Using RADIUS proxies to scale authentications

Internet Access for Business Partners

The following is the behavior of most wireless APs in use today with respect to the receipt of RADIUS Access-Accept and Access-Reject messages:

- When the wireless AP receives an Access-Accept message, the connection is allowed

- When the wireless AP receives an Access-Reject message, the connection is denied

To allow a business partner, vendor, or other non-employee to gain access to a separate network using the same wireless infrastructure that allows employees to access to the organization intranet, the connection request must result in an Access-Accept message from the RADIUS server. To get an Access-Accept message from the RADIUS server, you must either use guest access or the business partner, vendor, or other non-employee must have a valid account and certificates.

Using Guest Access

Guest access occurs when wireless clients are connected without sending a user identity. The wireless client does not provide a user name or credentials to the wireless AP. Therefore, the wireless AP does not include user identity (the User-Name attribute) or credential attributes in the Access-Request message. When the IAS server receives an Access-Request message that contains no user identity or credentials attributes, it verifies whether unauthenticated access is enabled for the remote access policy that matches the connection attempt. If a user identity attribute is not included, the IAS server uses the Guest account to obtain user account dial-in properties and group membership. If a user identity attribute is included but credential attributes are not, the IAS server uses the indicated account to obtain user account dial-in properties and group membership.

Restricted network access for guest access clients is supported on wireless APs by using IP filtering or VLANs. To specify a virtual LAN identifier for unauthenticated access, configure the Tunnel-Type and Tunnel-Pvt-Group-ID attributes on the advanced properties of the appropriate remote access policy.

For more information about unauthenticated and guest access with IAS, see Windows 2000 Server Help or Windows Server 2003 Help and Support.

Using Validated Access

For validated access for business partners, vendors, or other non-employees, you must create computer and user accounts and issue certificates for each business partner, vendor, or other non-employee. Next, create groups with these accounts as members so that you can manage access using group-based remote access policies. For example, create a WirelessInternetUsers that contains global groups of business partner, vendor, or other non-employee user and computer accounts.

To configure a wireless remote access policy for Internet access for business partners, vendors, or other non-employees, create a new custom remote access policy for wireless Internet access with the following settings:

- Policy name: Wireless access to Internet (example)
- Conditions: NAS-Port-Type=Wireless-Other or Wireless-IEEE 802.11, Windows-Groups=WirelessInternetUsers
- Permissions: Select **Grant remote access permission**.
- Profile, **Authentication** tab: For Windows 2000 IAS, select **Extensible Authentication Protocol** and the **Smart Card or other Certificate** EAP type. Clear all other check boxes. If you have multiple computer certificates installed on the IAS server, click **Configure**, and then select the appropriate computer certificate. For Windows Server 2003 IAS, clear all other check boxes. Click **EAP Methods** and add the **Smart Card or other Certificate** EAP type. If you have multiple computer certificates installed on the IAS server, click **Edit**, and then select the correct computer certificate.

- Profile, **Encryption** tab: If the wireless AP supports the MS-MPPE-Encryption-Policy and MS-MPPE-Encryption-Types RADIUS attributes, clear all other check boxes except the **Strongest** check box. This forces all wireless connections to use 128-bit encryption. If they are not, clear all the check boxes except **No encryption**.
- Profile, **Advanced** tab (if the wireless AP supports VLANs):
  - Add the Tunnel-Type attribute with the value of "Virtual LANs (VLAN)".
  - Add the Tunnel-Pvt-Group-ID attribute with the value of the VLAN ID of the VLAN that is connected to the Internet.
- If the wireless APs require vendor specific attributes (VSAs), you must add the VSAs to the appropriate remote access policies. For more information, see the "Configure vendor-specific attributes for a remote access policy" procedure previously described.

Using a Third-Party CA

You can use third-party CAs to issue certificates for wireless access as long as the certificates installed can be validated and have the appropriate properties.

Certificates on IAS Servers

For the computer certificates installed on the IAS servers, the following must be true:

- They must be installed in the Local Computer certificate store.
- They must have a corresponding private key. When you view the properties of the certificate with the Certificate snap-in, you should see the text **You have a private key that corresponds to this certificate** on the **General** tab.
- The cryptographic service provider for the certificates supports SChannel. If not, the IAS server cannot use the certificate and it is not selectable from the properties of the **Smart Card or Other Certificate** EAP type from the **Authentication** tab on the properties of a profile for a remote access policy.
- They must contain the Server Authentication certificate purpose (also known as an Enhanced Key Usage [EKU]). An EKU is identified using an object identifier (OID). The OID for Server Authentication is "1.3.6.1.5.5.7.3.1".
- They must contain the fully qualified domain name (FQDN) of the computer account of the IAS server computer in the Subject Alternative Name property.

Additionally, the root CA certificates of the CAs that issued the wireless client computer and user certificates must be installed in the Certificates (Local Computer)\Trusted Root Certification Authorities\Certificates folder.

Certificates on Wireless Client Computers

For the user and computer certificates installed on wireless client computers, the following must be true:

- They must have a corresponding private key.
- They must contain the Client Authentication EKU (OID "1.3.6.1.5.5.7.3.2")
- Computer certificates must be installed in the Local Computer certificate store.

- Computer certificates must contain the FQDN of the wireless client computer account in the Subject Alternative Name property.
- User certificates must be installed in the Current User certificate store
- User certificates must contain the universal principal name (UPN) of the user account in the Subject Alternative Name property.

Additionally, the root CA certificates of the CAs that issued the IAS server computer certificates must be installed in the Certificates (Local Computer)\Trusted Root Certification Authorities\Certificates or Certificates (Current User)\Trusted Root Certification Authorities\Certificates folder.

Configuring Proxy Server Settings

Certificates issued from third-party CAs, such as VeriSign, Inc., can contain a certificate revocation list (CRL) uniform resource locator (URL) that points to an Internet Web site. If the IAS server cannot reach the Internet Web site to perform certificate revocation checking, it cannot validate the certificates of wireless clients for EAP-TLS authentication.

Many enterprise networks use a proxy server, such as Microsoft Internet Security and Acceleration Server (ISA), to access Internet services. Configuration of proxy server settings is normally done through Dynamic Host Configuration Protocol (DHCP) options. However, many IAS servers have a static IP address configuration and therefore might not be properly configured with the appropriate proxy server settings to access the Internet. The result is that IAS servers cannot perform certificate revocation checking for its own local computer certificate or wireless client certificates and authentication can fail for all wireless connections.

To configure an IAS server with the appropriate proxy server settings so that it can access Internet services, do the following:

1. On the IAS server, login using an account that has local administrator permissions.
2. Open a command prompt.
3. At the command prompt, type **time** and press ENTER.
4. At the **Enter the new time:** prompt, press ENTER.
5. At the command prompt, type **at** *[time+1 minute]***/interactive "cmd.exe"** and press ENTER. For example, if the current time from step 4 is 13:31, the command is **at 13:32/interactive "cmd.exe"**.
6. After a minute, a new command prompt opens. Commands run from this command prompt execute in the local system security context. IAS also runs in the local system security context. Therefore, you must configure proxy server settings from the local system security context so that they apply to IAS. Otherwise, the proxy server settings only apply to the user account that was used to login to the IAS server in step 1.
7. From inside the new command prompt, type **"%programfiles%\Internet Explorer\Iexplore.exe"** (including the quotes) and press ENTER. This opens Internet Explorer in the local system security context.
8. Click **Tools**, and then click **Internet Options**.
9. Click the **Connections** tab, and then click **LAN Settings**.
10. In **Proxy server**, select **Use a proxy server for your LAN**.
11. Type the name or IP address of your proxy server in **Address**, then type the Web port number (typically 80) in **Port**. Example: if the name of your proxy server is CorpProxy and you use port 80 for your Web traffic, you would type **corpproxy** in **Address** and **80** in **Port**
12. Click **OK** to save the proxy server settings.

13 Click **OK** to close the **Internet Options** dialog box.

14 Close Internet Explorer.

15 Close the new command prompt that was opened in step 6.

Another way to configure proxy server settings is to use the ProxyCfg.exe tool from the command prompt opened in step 6. ProxyCfg.exe is included with Windows Server 2003. For a version of ProxyCfg.exe that works with Windows 2000 Server, see 830605 - The Proxycfg.exe configuration tool is available for WinHTTP 5.1. For more information about how to use ProxyCfg.exe, see ProxyCfg.exe, a Proxy Configuration Tool.

4 Windows Recommendations and Best Practices

The following are recommendations and best practices for deploying an IEEE 802.11 WLAN in a large enterprise.

Security

Microsoft recommends that you use one of the following combinations of security technologies (in order of most to least secure):

- **WPA2 with EAP-TLS and both user and computer certificates** - EAP-TLS is the strongest 802.1X authentication method supported by Windows-based wireless clients. For the highest security, configure your PKI to issue both user and computer certificates for wireless access.
- **WPA2 with PEAP-MS-CHAP v2 and require strong user passwords -** If a PKI deployment is not possible or desirable, you can use PEAP-MS-CHAP v2. PEAP-MS-CHAP v2 can be used to provide strong password-based authentication of wireless clients, but only when used in conjunction with the requirement of strong user password policies on your network.
- **WPA with EAP-TLS and both user and computer certificates -** If your wireless equipment supports WPA but not WPA2, use WPA with EAP-TLS.
- **WPA with PEAP-MS-CHAP v2 and require strong user passwords** - If your wireless equipment supports WPA but not WPA2 and you do not want to deploy a PKI, use WPA with PEAP-MS-CHAP v2.

The following combinations of security technologies (in order of most to least secure) are discouraged from use except if used temporarily when transitioning to a WPA2 or WPA-based security configuration:

- **WEP with 802.1X authentication, EAP-TLS with both user and computer certificates, and periodic reauthentication** - If your wireless equipment does not support WPA2 or WPA, you can use WEP with EAP-TLS-based 802.1X authentication and both user and computer certificates. To change the per-client WEP encryption key for a wireless client session, force your wireless clients to periodically reauthenticate by configuring your wireless APs or RADIUS-based authentication servers.
- **WEP with 802.1X authentication, PEAP-MS-CHAP v2, periodic reauthentication, and enforce strong user passwords** - If your wireless equipment does not support WPA2 or WPA and you are not deploying a PKI, you can use the combination of WEP, 802.1X, and PEAP-MS-CHAP v2. However, you must also require strong user passwords and force your wireless clients to periodically reauthenticate.

PKI

For the certificates used for wireless access, use the following best practices:

- To install computer certificates, use auto-enrollment - This requires the use of a Windows 2000 or Windows Server 2003 Certificate Services server as an enterprise CA at the issuer CA level.

- To install user certificates, use auto-enrollment - This requires the use of a Windows Server 2003, Enterprise Edition, or Windows Server 2003, Datacenter Edition, Certificate Services server as an enterprise CA at the issuer CA level.
- Otherwise, to install user certificates, use a CAPICOM script - Alternately, use a CAPICOM script to install both computer and user certificates.
- Because certificate revocation checking can prevent wireless access due to the unavailability or expiration of CRLs for each certificate in the certificate chain, design your PKI for high availability of CRLs. For instance, configure multiple CRL distribution points for each CA in the certificate hierarchy and configure publication schedules so that the most current CRL is always available

Altitude APs

When choosing and deploying Altitude APs, use the following best practices:

- Use Altitude APs that support WPA2 or WPA. If you must use Altitude APs that support only WEP, ensure that they support 802.1X, 128-bit WEP, and the use of both multicast/global and unicast session encryption keys.
- Change the administration configuration of the Altitude AP, such as administrator-level user names and passwords, from its default configuration.
- If you are installing Altitude AP in the plenum area, the space between the ceiling tiles and the ceiling, you must obtain plenum-rated wireless APs to comply with fire safety codes.
- To minimize cross talk on the 802.11b wireless frequencies in the S-Band ISM frequency range, overlapping coverage areas should have a five-channel separation. For example, in the United States, use channels 1, 6, and 11.
- If you are using SNMP to manage or configure Altitude APs, change the default SNMP community name. If possible, use Altitude APs that support SNMPv2.

Wireless Network Adapters

When choosing and deploying wireless network adapters, use the following best practices:

- Use wireless network adapters whose drivers support Windows XP Wireless Auto Configuration.
- Use wireless network adapters that support WPA2 or WPA. If you must use wireless network adapters that support only WEP, ensure that they support 128-bit WEP encryption keys and both multicast/global and unicast session keys.
- Avoid installing wireless configuration tools that are provided with the wireless network adapter and use Windows XP Wireless Auto Configuration.
- For easier deployment, use wireless network adapters that have Plug and Play drivers already included with Windows XP or are available through Windows Update (http://www.windowsupdate.com).

Active Directory

When configuring Active Directory for wireless access, use the following best practices:

- If you have a native-mode domain and are using a group-based wireless remote access policy, use universal groups and global groups to organize your wireless accounts into a single group. Additionally, set the remote access permission on computer and user accounts to **Control access through Remote Access Policy**.
- If you are using a Windows 2000 enterprise CA as an issuing CA, use the Computer Configuration **Automatic Certificate Request Settings** Group Policy setting to automatically issue computer certificates to all domain members. Ensure that all appropriate domain system containers are configured for automatic enrollment of computer certificates, either through the inheriting of group policy settings of a parent system container or explicit configuration.

RADIUS

When deploying your RADIUS infrastructure for wireless access, use the following best practices:

- If supported by your Altitude APs, use Internet Protocol security (IPsec) and Encapsulating Security Payload (ESP) to provide data confidentiality for RADIUS traffic between the Altitude AP and the IAS servers and between IAS servers. Use 3DES encryption and, if possible, certificates for Internet Key Exchange (IKE) main mode authentication. IPsec settings for RADIUS traffic sent between IAS servers can be configured using Group Policy and assigned at the Active Directory system container level. For more information about IPsec, see the Windows Server 2003 IPsec Web site (http://www.microsoft.com/windowsserver2003/technologies/networking/ipsec/default.mspx)
- To provide the maximum security for unprotected RADIUS traffic, choose RADIUS shared secrets that are random sequences of upper and lowercase letters, numbers, and punctuation at least 22 keyboard characters long. If possible, use a random character generation program to determine shared secrets to configure on the IAS server and the Altitude AP.
- Use as many different RADIUS shared secrets as possible. The actual number of RADIUS shared secrets depends on configuration constraints and management considerations. For example, IAS allows the configuration of RADIUS shared secrets on a per-client or per-server basis. However, many wireless APs allow for the configuration of a single RADIUS shared secret for both primary and secondary RADIUS servers. In this case, a single RADIUS shared secret is used for two different RADIUS client-RADIUS server pairs: the wireless AP with its primary RADIUS server and the wireless AP with its secondary RADIUS server. Additionally, if you are using the **netsh aaaa show** and **netsh exec** commands to copy the configuration of one IAS server (the primary) to another (the secondary), the RADIUS shared secret for each Altitude AP/primary IAS server pair must be the same as the RADIUS shared secret for each Altitude AP/secondary IAS server pair. Because the Windows Server 2003, Enterprise Edition, and Windows Server 2003, Datacenter Edition versions of IAS allows you to configure a range of IP addresses to define a single RADIUS client (for example, all the Altitude APs on a single subnet in a single building at Microsoft), all the wireless AP/IAS server pairs defined by the IAS RADIUS client are configured with the same RADIUS shared secret.
- When there are separate account databases, such as different Active Directory forests or domains that do not have two-way trusts, you must use a RADIUS proxy between the Altitude APs and the RADIUS servers that are providing the authentication and authentication processing. Windows Server 2003 IAS supports RADIUS proxy functionality through the configuration of connection request policies and remote RADIUS server groups. For this example, connection request policies are created to match different portions of the User-Name RADIUS attribute corresponding to each

account database (such as different Active Directory forests). RADIUS messages are forwarded to a member of the corresponding remote RADIUS server group matching the connection request policy.

- Investigate whether the Altitude APs need RADIUS vendor-specific attributes (VSAs) and configure them during the configuration of the remote access policy on the **Advanced** tab of the remote access policy profile.

Scalability

When designing for scalability, use the following best practice:

- For a large amount of authentication traffic within an Active Directory forest, use a layer of RADIUS proxies running Windows Server 2003 IAS between the wireless APs and the RADIUS servers.
- By default, an IAS RADIUS proxy balances the load of RADIUS traffic across all the members of a remote RADIUS server group on a per authentication basis and uses failover and failback mechanisms. Members of a remote RADIUS server group can also be individually configured with priority and weight settings so that the IAS proxy favors specific RADIUS servers.

Using Computer-only Authentication

Some network administrators want to use only computer authentication. By using only computer authentication, a wireless client computer must perform computer-level 802.1X authentication with a Altitude AP using either a computer certificate (when using EAP-TLS authentication) or the computer's account name and password (when using PEAP-MS-CHAP v2 authentication) before it can access the organization network. With computer-only authentication, only valid computers can connect to the wireless network. Computers that do not have a computer account in the organization's domain cannot connect. This prevents users from bringing computers from home and connecting to the organization's wireless LAN. Home computers represent a threat to the organization network because they are not managed in the same way as member computers and can introduce viruses or other malicious programs into the organization network.

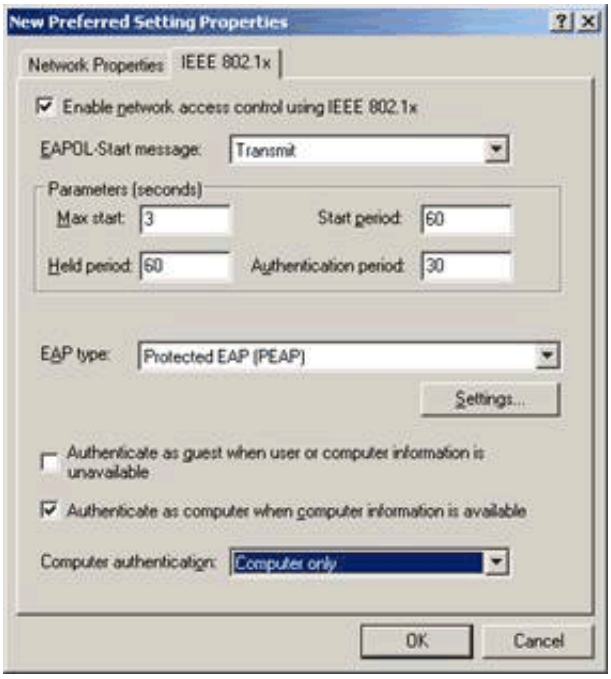
For more information about computer authentication and user authentication, see "Windows XP Wireless Deployment Technology and Component Overview" at http://www.microsoft.com/technet/prodtechnol/winxppro/maintain/wificomp.mspx.

You can configure computer-only authentication using the Wireless Network (IEEE 802.11) Policies Group Policy extension or through the registry.

Configuring Computer-only Authentication using the Wireless Network (IEEE 802.11) Policies Group Policy Extension

To configure computer-only authentication using the Wireless Network (IEEE 802.11) Policies Group Policy extension, select Computer only in Computer authentication on the 802.1x tab for the preferred network the corresponds to your wireless network. Figure 4 shows an example.

Figure 6: Selecting computer-only authentication in the Wireless Network (IEEE 802.11) Policies Group Policy extension



For more information, see Configuring Wireless Settings Using Windows Server 2003 Group Policy at http://www.microsoft.com/technet/community/columns/cableguy/cg0703.mspx.

Enabling Computer-only Authentication Using the Registry

To configure computer-only authentication through the registry, all the Windows-based wireless clients must have the following registry value set:

HKEY_LOCAL_MACHINE\Software\Microsoft\EAPOL\Parameters\General\Global\AuthMode=2

With the AuthMode setting set to 2, only computer authentication is attempted. User authentication is never attempted.

To add this registry setting on all of your computers running Windows, you can use the following tools:

- Regini.exe from the Windows 2000 Server Resource Kit Tools
- Reg.exe from the Windows Server 2003 Resource Kit Tools

In both cases, you create a script file that is read by the tool to add a registry setting. The tool has to be run in the security context of a local administrator account.

Alternately, you can use network management software to change registry settings on managed computers.

Summary

You can perform secure wireless authentication with either EAP-TLS or PEAP-MS-CHAP v2. For EAP-TLS, you must deploy a certificate infrastructure capable of issuing computer certificates to your IAS servers and both computer and user certificates to your wireless client computers and users. For PEAP-MS-CHAP v2, you only need to install computer certificates on the IAS servers, provided that the appropriate root CA certificates are already installed on the wireless clients. For both cases, you must manage your Active Directory users and groups for wireless access, configure your IAS servers as RADIUS servers to the Altitude APs, and configure your Altitude APs as RADIUS clients to the IAS servers. You can also configure Internet access for business partners, use third-party CAs, and use IAS RADIUS proxies for cross-forest authentication or load balancing.

5 Summit WM series switch WM200/2000 Diagnostics

WARNING!

Changes or modifications made to the Summit WM series switch or the Altitude APs which are not expressly approved by Extreme Networks could void the user's authority to operate the equipment.

Only authorized Extreme Networks service personnel are permitted to service the system. Procedures that should be performed only by Extreme Networks personnel are clearly identified in this guide.

WM200/2000 Filesystem Constraints

The WM200/2000 System has the following constraints:

- 1GB Disk Space available
- Reduced number of partitions to 4
- Separate Partitions for logging and application storage (Backup Images, Image Storage for Summit WM series switch and Altitude AP.

Table 5 shows the filesystem constraints for the Summit WM series switch.

Table 5: WM200/2000 Filesystem Constraints

Filesystem	Size	Comment
/	600MB	Main partition – Installs OS, User accounts, application components, system logs
/var/controller/images	200MB	Storage area for system related images – Application RPM, OSUpdate packages, AP images
/var/controller/log	128MB	Stores application related logs
/var/controller/cdr	32MB	Stores user CDRs
/tmp	128MB	Memory mapped filesystem for quick IO operations off Flash

NOTE

A separate rescue partition is also installed providing a method of rescue installation.

WM200/2000 System Capacity

The Summit WM series switch WM200/2000 has two models. The Campus model and Enterprise model consist of the same hardware, and have their system capacity limited based on the applied license key. A special license key is available to upgrade from Campus to Enterprise capacity.

Table 6 shows the system capacities for each model.

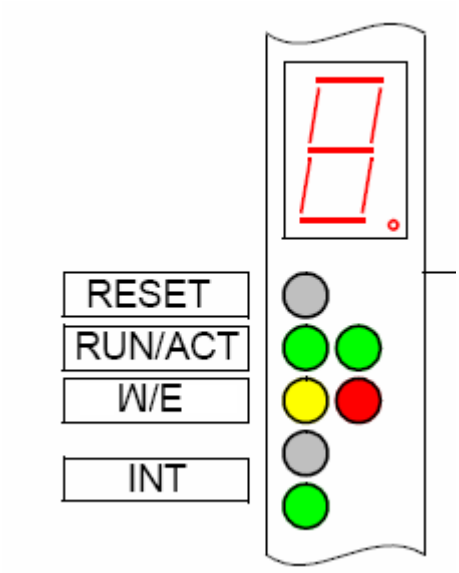
Table 6: WM200/2000 System Capacity

	WM200/2000 Campus	WM200/2000 Enterprise
Number of APs	100	200
Number of Users	2048 + 2048	4096 + 4096
Number of WM-AD	32	64
Number of Voicecalls	200	500
Maximum Throughput	2Gbps	2GBPS
Part Number	F31505-K80-A21	F31505-K80-A22

LED Indicators

The SME is the main entity in charge of system monitoring and state reporting. The LED states for the card represent the system states.

Figure 7: System LED diagram



The reported states for the Summit WM series switch WM200/2000 are:

- **Run LED** - This indicator indicates CPU activity. Once CPU initialization is complete, the Run LED blinks with CPU activity.
- **Activity LED** - This indicator will be turned on upon application (SMT) start. It indicates that the system in now under application control. It also indicates health monitor for app/system initialization and provides a reset context for error codes.
- **Warning/Error LED** - The Yellow (Warning) and Red (Error) indicators are ALARM LEDs signalling a problem state. These LEDs are used by the application to indicate the running state of the system. The corresponding error code is displayed in the SSD and a corresponding error alert is provided in through the Log system.

The Seven-Segment Display (SSD) is used to provide information about startup or processor load.

NOTE

The error codes represented by the SSD are context dependent on the state of the LEDs (ACT, W, E).

System Startup

The firmware and bootloader procedures execute the system startup phase. Table 7 provides SSD descriptions.

Table 7: SSD definitions

SSD	Description
0	The processor has started. The firmware has taken control. This SSD is short and rarely in running systems.
4	Check Firmware consistency, ev. update
5	Format Memory
6	Initialize load device
9	Load subsystem
b	Start operating System, System active

The SSD b is displayed to indicate that the OS has started. This is followed by multiple subsystem specific information signs. Each sign represents a subsystem in ascending order. When everything is OK, the display returns to SSD b.

In case of error during startup, an E with a numeric error-code flash on the SSD to identify the error.

Application States

The Activity LED becomes active to indicate that the system has completed startup diagnostic procedures (POST), and the OS has properly loaded. The Act LED indicates that the Summit WM Series WLAN Switch Software is running. The corresponding running state of the application is indicated in the SSD. All other LEDs default to off unless otherwise specified. The Activity, Minor/Major, INT and SSD are available to report running codes.

Table 8: WM200/2000 Application States

Condition	Log Level	Comment	Action
Activity LED			
Application initialization started. • Activity LED = Enabled • SSD= 0	Syslog	Application has initialized and began to load system components.	No Action Required

Table 8: WM200/2000 Application States (Continued)

Condition	Log Level	Comment	Action
Forwarding Engine initialization complete. Application initializing. • Activity LED = Enabled • SSD= 1	Major	FE initialization complete	No Action Required
Application initialization complete. System active. • Activity LED = Enabled • SSD= A	Major	Complete set of application components have restarted. System is now ready to enter active state.	No Action Required
System halted. Administrator requested halting of system. • Activity LED = Enabled • SSD= H	Major	This SSD code indicates that the administrator has requested the halting of system's operations. The system is in halted state.	Reset system power to restore operational state.
Warning LED			
High Temperature reached • Activity LED = Enabled • Warning LED = Enabled • Alarm = MAJOR • SSD= 1	Major (set) Info (reset)	Temperature in one of the system's sensors has reached high threshold notification of occurrence.	Check speed/state indicators for FANs. Check for proper airflow access. If problem persists, contact Technical Support.
Fan unit failure. Rotation counter indicates Zero speed for one of the lateral trays. May be result of tray removal. • Activity LED = Enabled • Warning LED = Enabled • Alarm = MINOR • SSD= 2	Minor	Rotation counter for Fan indicates Zero for one of the lateral trays. May also be the result of fan tray removal (hot swap) System is at risk of over-heating.	Re-insert fan tray. If card present, contact Technical Support.
Power supply failure. Failed to detect one of the power supplies, may have been removed. • Activity LED = Enabled • Warning LED = Enabled • Alarm = MAJOR • SSD= 3	Major	Failure Detected for one of the power supplies	Re-insert power block. If block present, contact Technical Support.
FDD low sector count (40 backup sectors remaining). • Activity LED = Enabled • Warning LED = Enabled • Alarm = MAJOR • SSD= 4	Major	Media Storage utilization has only 40 free blocks available leveling. Card is getting close to max sector re-use	Contact Technical Support to arrange replacement.
FDD extremely low sector count (20 backup sectors remaining). • Activity LED = Enabled • Warning LED = Enabled • SSD= 5	Major	Media Storage utilization has reached critical level of free sector utilization. No more free-sectors available. - Recommend replacement.	Contact Technical Support to arrange replacement.

Table 8: WM200/2000 Application States (Continued)

Condition	Log Level	Comment	Action
Error LED			
Failed to identify FDD. Possibly due to removal of FDD card. l Activity LED = Enabled l Warning LED = Enabled l Error LED = Enabled l SSD= 1			Re-insert card. If card present, contact Technical Support to arrange replacement.
Failed to initialize NPE card. l Activity LED = Enabled l Warning LED = Enabled l Error LED = Enabled l SSD= 2			Re-insert card. If card present, contact Technical Support to arrange replacement.
Critical threshold reached (95C for NPE). System will reboot. l Activity LED = Enabled l Warning LED = Enabled l Error LED = Enabled l SSD= 3			Check speed/state for fans. Check for proper airflow access. If problem persists, contact Technical Support,
Full fan assembly failure (both trays). System will reboot. l Activity LED = Enabled l Warning LED = Enabled l Error LED = Enabled l SSD= 4			Re-insert fan tray. If card present, contact Technical Support to arrange replacement.
Application initialization failure. Startup manager failed to initialize all of system's components. system will reboot. l Activity LED = Enabled l Warning LED = Enabled l Error LED = Enabled l SSD= 5			If problem persists, contact Technical Support.
Lost connectivity with FE. Possible failure of NPE card. System will reboot. l Activity LED = Enabled l Warning LED = Enabled l Error LED = Enabled l SSD= 6			Investigate failure condition in `/var/controller/log/logs/ixcapture.log` If problem persists, contact Technical Support.
MCE failure. Backup sectors exhausted. l Activity LED = Enabled l Warning LED = Enabled l Error LED = Enabled l SSD= 7			Contact Technical Support to arrange replacement.

Table 8: WM200/2000 Application States (Continued)

Condition	Log Level	Comment	Action
NPE Initialization Failure. Firmware self test (BIST) has detected failure with one component (memory, bus, interconnects) l Activity LED = Enabled l Warning LED = Enabled l Error LED = Enabled l SSD= 8			Contact Technical Support to arrange replacement.

SNMP Alarms are generated for each of the conditions corresponding to Major and Critical logs.

6 Summit WM series switch WM200/2000 Hardware maintenance

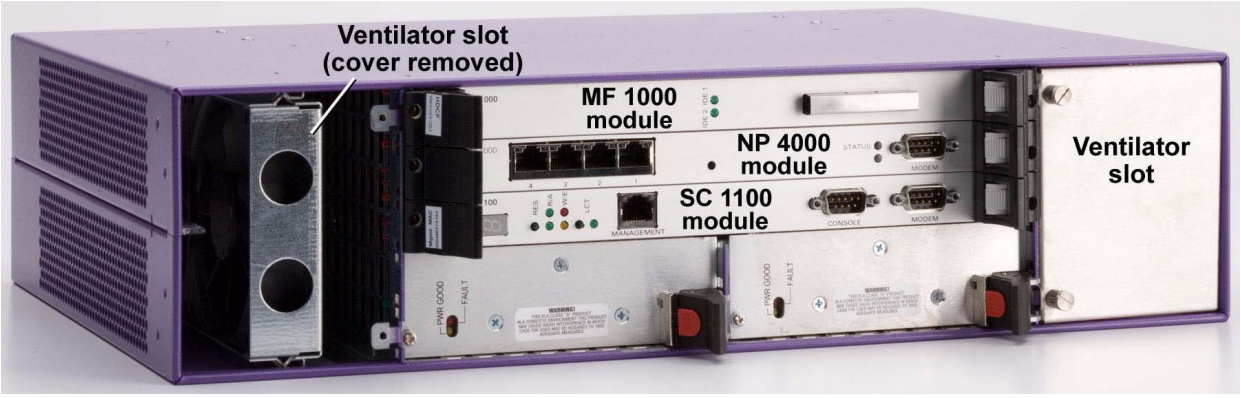
WARNING!

The Summit WM series switch WM200/2000 system may not be operated in a LAN in which a DC voltage is overlaid on the data lines, since there are still switches that connect directly without checking the supply voltage first. Depending on the transformer at the LAN interface, voltages of up to 500 V can be induced. Such peak voltages usually lead to destruction of the physical LAN controller's logic.

Summit WM series switch WM200/2000 (Figure 8) consists of a cassette with a cPCI backplane, SC 1100 card, MF 1000 card, NP 4000 card, power supply unit and redundant fan modules. Depending on the power supply module used, it can operate with either 110 or 230V AC.

There is no electrical connection between the access point and the Summit WM series switch WM200/2000. The Summit WM series switch WM200/2000 and access points communicate with each other exclusively via the IP network. For more information, see the *Summit WM Series WLAN Switch and Altitude Access Point Software Version 4.1 User Guide*.

Figure 8: Summit WM series switch WM200/2000 front panel



MF 1000, SC 1100 and NP 4000 maintenance is achieved by replacing the affected parts.

WARNING!

You should properly shutdown the system prior to performing any maintenance on the system's main processing components, including the MF 1000, SC 1100, and NP 4000 cards. For more information, see "Turning off the redundant AC-Powered, Summit WM series switch WM200/2000" on page 72.

Power FRUs

This section describes the power field replaceable units (FRUs) for Summit WM series switch WM200/2000. It also provides procedures for removing, replacing, and verifying each FRU.

Summit WM series switch WM200/2000, AC-powered, redundant system

The power FRUs on an AC-powered redundant Summit WM series switch WM200/2000 system is two AC-to-DC shelf power supply units (ACPCI) on the Summit WM series switch WM200/2000 shelf.

Fan Tray

The fan tray (Figure 9) is a plug-in unit for 19-inch houses and consists of two 12-Vdc fans. It is suitable for on-site installation and replacement. An air current (from left to right) of 84 m3/h per fan is sufficient. Each fan generates a square wave, open collector signal that is proportional to the fan speed. The absence of this signal indicates a fan problem in the system. The fan tray is hot swapable. In order to replace the fan tray, the two screws on the fan tray cover must be removed.

WARNING!

Exercise caution in removing fan trays. It is recommended to waiting until the fans stop rotating before removing the fan trays.

Figure 9 shows the fan model used: the PAPST 3412 N/2.

Figure 9: Fan Tray

The fan trays are positioned on the left and right in the Summit WM series switch WM200/2000 shelf. Each fan features three conductors (12 V, ground (GND), speed signal). The fan trays are connected to the backplane by a connection cable.

Figure 10 indicates the position of fan trays in the CSPCI shelf, as well as the numbering of the fans. Figure 11 shows a side view of the fans.

Figure 10: Fan tray position and numbering of fans

Figure 11: Side view of fans

MF1000

The MF1000 card (Figure 12) consists of a 1GB Flash Disk Drive. This card provides the persistent storage for the system. This card should not be unplugged during the live operation of the system. The system should be powered down prior to removal of the card, to prevent any loss or corruption of persisted data.

Prior to powering down the system, the system's services should also be halted through the administration interface.

Figure 12: MF1000 card

The MF1000 card includes:

- **Hardware Part Number** – MF1000 (including Flashdrive) S30810-K2319-X100
  - WM200/2000 Media Services Engine (MSE 2011)
- **LEDs** – The front side of the card features two green LEDs (IDE1 = HD/IDE2 = MO) that indicate the status of the individual drives.
- **Compact Flash** – A compact flash interface is also available on the card. Usage of this interface is not supported in release V4.x.

SC 1100 card

The SC 1100 card (Figure 13) is a full size (6U) Compact PCI (cPCI) form-factor card.

Figure 13: SC 1100 card

The SC 1100 card has the following main components:

- Pentium M processor
- Micron North Bridge with dual PCI bus
- 1GB DDR memory
- Dual stage Watchdog timer
- Two signal interfaces from redundant PSU that provide the following information to CPU (registered and memory mapped):
  - Provide alarm from PSU to s/w if redundant power module failed
- 2 MB of onboard Flash (used for system Bootrom, diagnostic, system serial number, Extreme-specific MAC address for Eth ports, etc…; accessible by s/w applications).
- Management ports:
  - Main: 10/100BT LAN (RJ45) with Extreme-specific MAC address, activity LED (bi- color) and speed LED (bi- color).
  - Console access port: RS-232 (DB9) serial interface
- CPU card will provide 7-segment LED display and 4 status LEDs (under s/w control) as a way to visually communicate with service personnel and end users
- One Reset button (external)

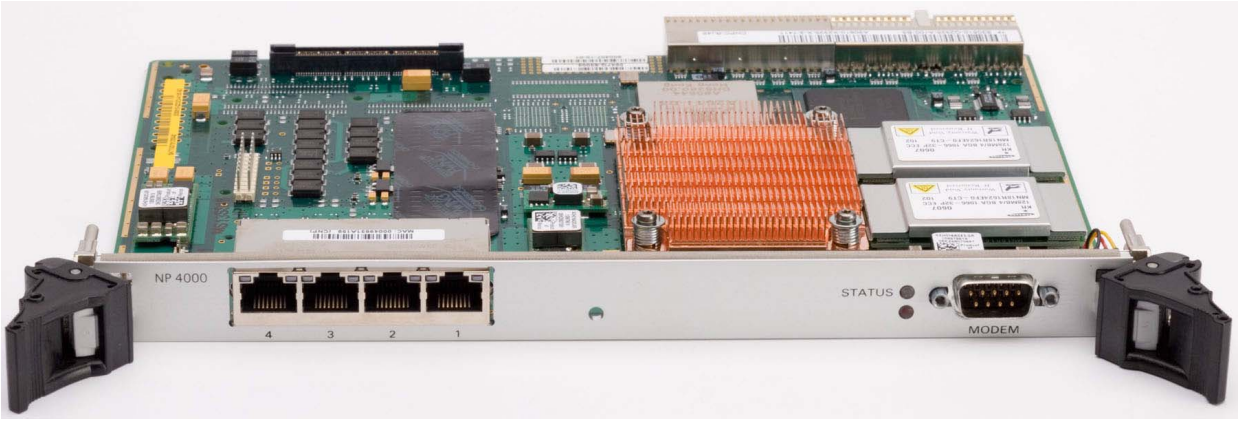
NOTE

Replacing the SC 1100 blade, will alter the MAC address of the management interface with is key to the product licensing system. As such, replacement of the SC 1100 requires that the product key be transferred from the old SC 1100 card's MAC to the new one. This transfer should be arranged through tech support/sales support.

NP 4000 card

The NP 4000 card (Figure 14) is a full size (6U) Hot-swap-able Compact PCI (cPCI) form-factor card.

Figure 14: NP 4000 card



The NP 4000 card has with the following main components:

- Network processor unit
- 256MB of RDRAM
- 32MB of QDR SSRAM
- Non-transparent PCI bridge (Intel 21555) to provide 33/66MHz 32/64-bit PCI bus connectivity between NPU PCI interface and cPCI backplane
- 12-port SPI4.2 Gigabit Mac
- 4 x front-accessible Gigabit (data) ports

NOTE

Replacing the NP 4000 alters the MAC addresses of the system data ports. New MAC addresses are advertised on the network in relation to the system interface IPs. You must ensure that no specific network topology is in place which can be affected by the MAC address change to the network. The IP addresses for the system do not change.

Power and maintenance procedures

This section provides procedures to power off and power on the system when performing maintenance. Using the matrices will help to eliminate system problems.

Tools and equipment required

Use the following tools and equipment to power on the system and verify system power:

- ESD kit
- Phillips screwdriver

Maintaining the ESD wrist strap

The ESD wrist strap and cord must operate properly to guard against ESD damage and electrical shocks. The wrist strap and cord assembly has a 1-megohm resistor; if the resistor fails, there is no ESD protection.

NOTE

Check the wrist strap weekly to ensure proper ESD protection.

To test the ESD wrist strap using a DMM:

1 Set the ohmmeter to 2-megohm resistance (see Figure 15).

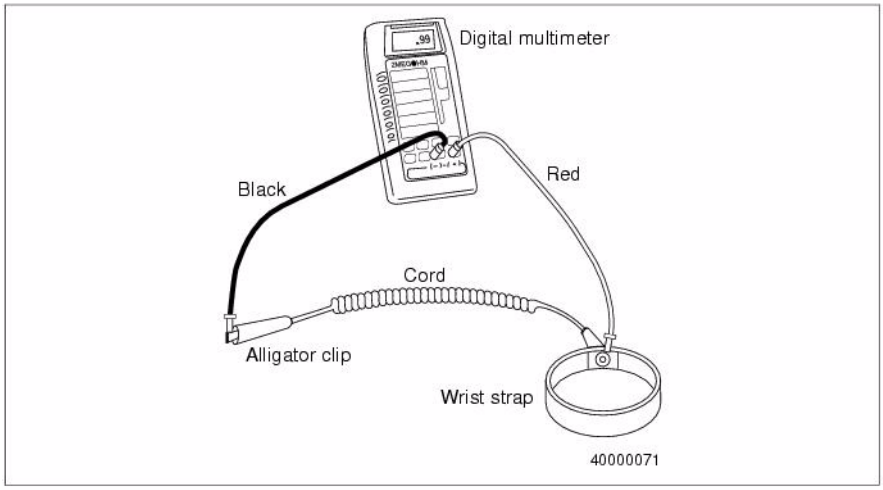
2 Connect the DMM black lead to the alligator clip at the end of the cord.

3 Contact the DMM red lead to the plate on the inner surface of the wrist strap.

4 Check the resistance reading on the meter. The meter reading must be between 0.80 and 1.20 mega ohms.

5 Replace the wrist strap and cord assembly if the reading is not within the allowable range.

Figure 15: ESD Wrist Strap and Cord Assembly



Using electrostatic discharge prevention procedures

Always follow the electrostatic discharge (ESD) prevention procedure when you remove and replace cards. Failure to follow the ESD prevention procedure can result in permanent or intermittent card failures.

WARNING!

ATTENTION: *Static Sensitive Devices—Observe all precautions for electrostatic discharge.*

WARNING!

DANGER: *To avoid electrical shock, never wear the ESD wrist strap while working on the power system or at the back of the cabinet.*

To perform ESD prevention procedures:

1 Check the ESD wrist strap weekly to ensure proper ESD protection (refer to "Maintaining the ESD wrist strap" on page 70 and Figure 15).

2 Attach the ESD wrist strap to your bare wrist. Ensure that the inside of the strap makes good contact with your skin (see Figure 7-2).

3 Attach one end of the coiled wire to the wrist strap and the other end to the alligator clip, if necessary.

4 Connect the alligator clip to an unpainted portion of the cabinet frame. This safely channels electrostatic charges to ground.

5 Observe the following ESD prevention guidelines during the performance of system maintenance procedures:

- Handle cards by their edges only

WARNING!

WARNING: *Avoid contact between the card and your clothing. Electrostatic charges on clothing can damage the card. The wrist strap protects the card from electrostatic charges on your body only.*

- Immediately place any card you remove from the system into a static-shielding package.

WARNING!

DANGER: *The card must remain in a static-shielding bag or static-free box until the card is returned to the warehouse.*

- Do not remove a replacement card from its static-shielding packaging until you are ready to install it.

NOTE

This procedure applies to upgraded systems.

- Remove cards by pressing/pulling the cPCI card ears

NOTE

Cards are locked from manufacturing with a screw at each end. In order to remove a card, the holding screws must be removed.

Turning off the redundant AC-Powered, Summit WM series switch WM200/2000

To turn off redundant AC-powered Summit WM series switch WM200/2000, a shutdown/halt is recommended to ensure that system's processing operations are properly terminated prior to the power interruption.

Figure 16: Summit WM series switch WM200/2000 power switches

7 MAC Based Authentication

The MAC-based authentication is a new feature, designed to further control access to the network resources for the wireless clients over the Summit WM series switch, access points, and WLAN switch software system. It is based on the authentication of the client's MAC address using the same process as for the user's RADIUS authentication.

Only authenticated clients – MAC addresses can establish sessions and use network resources as defined by the rules for the virtual network segment. Depending on the assignment of the virtual segment (NONE, SSID and AAA), the user's authentication may be required. The MAC based authentication, in that sense, is more a form of authentication – giving permission to the wireless clients to enter the system. If the RADIUS server rejects the authentication, the Summit WM series switch will send the message to the Altitude AP and the Altitude AP will disconnect the client.

The feature is configurable per WM-AD via GUI as a part of the radius profile definition. It includes the radius redundancy with up to three radius servers.

It is also designed to work in cases of clients roaming and mobility. A wireless client can be forced to start the MAC-based authentication when roaming from one Altitude AP to another in the roaming and mobility cases.

How MAC-based authentication works

1. When a client attempts to associate with a WM-AD which has MAC-based authentication enabled, the Altitude AP triggers the association request, which will be forwarded through the control plane to the Security Manager, then to the Radius Client. The Radius Client will send the access request to the RADIUS server, containing the MAC address of the wireless client for the userId and password.
2. When Authentication Request is received, the Authentication Server validates the request (if it is coming from the known client – Summit WM series switch) and then decrypts the data packet to access the user name and password information, in this case the MAC address. This information is passed to the appropriate security system, which verifies the existence of the user and the correctness of the password, as well as the authentication type (PAP, CHAP, MS CHAP). Depending on the server, it can be a UNIX file, Active directory, etc.
3. If an account for the MAC address is defined on the RADIUS server, and it passes the security check, the RADIUS server will send the access accept to the Summit WM series switch, and the FE will create an MU session.
4. If the MAC address failed the security check, the RADIUS server will send the access reject to the Summit WM series switch. Upon receiving the access reject, the Summit WM series switch will send a message to the Altitude AP and the Altitude AP will disconnect the client.

Roaming

When a client roams from one Altitude AP to another, the MAC authentication is not required by default. The MAC authentication can be forced in the roaming case. It could happen that the user re-authentication is not required, but that the MAC re-authentication is.

Radius redundancy

If the primary server for the MAC authentication is not accessible, the radius redundancy will be triggered and the request will be sent to the next server. The expected behavior is similar to the description in the RADIUS redundancy documents.

Rejection and failure

There is a difference in handling rejection and failure.

Rejection is when the MAC address is rejected by the RADIUS servers.

Initially, the Radius server timeout was treated as rejection (MU_NOT_ALLOWED), but it has been changed. If the vnMgr does not receive a reply within the specified time, it will not send rejection to the MU Session Manager. Instead, it will send different message indicating authentication failure (MU_AUTH_ERROR). The same occurs for the timeout from the other components in the chain:

- Radius client timeout
- Security manager timeout
- WADMGR timeout

In order to avoid processing continuous request of unauthorized clients, the feature includes instant rejection by Altitude AP for defined duration, after which the record will be completely deleted and new authentication process may proceed. The rejected clients will not be in the black list, since the black list applies to all WM-ADs, while the restriction for a MAC-based authentication is WM-AD based.

For the MU association, if the MU Session Manager does not get a reply from the vnMgr within the 30 sec, it will send the failure to Wireless AP. Since the vnMgr can get another request from the same client, it will have different ID and the first reply will be dropped.

Additional RADIUS attributes

The access_accept may include the session timeout, which will be applied to the pre-authenticated session timer. It also may include the re-direction URL, which should be included in the filter definitions for the WM-AD.

Assumptions/recommendations

1 The MU session timeout is a very important factor in radius profiles definitions – timeouts. In order to avoid an infinitive loop, the radius redundancy should happen within 30 sec, otherwise the authentication requests will be sent to the non-responsive server.

2 MAC-based authentication is not available for the 3rd Party AP WM-AD

3 Altitude AP keeps records of rejected MAC addresses in the SIB table (Station Information Base), with the special status "cleared". The capacity of the table is 128 records. It could happen that the limit is reached, for example when a number of unknown clients (MAC addresses) attempts to authenticate. In that case a perfectly valid client can not associate, until a record in the SIB table is timed out (2-3 min).

Use Cases

The MAC-based authentication could be used in different ways, as described in the MRD and design document. It can be implemented as:

1 Corporate authentication mechanism.

2 Addition to the existing authentication mechanism in a form of the device (MAC) authentication.

In both cases the feature gives the network administrators an option to increase security by allowing association with a WM-AD to authorized devices only. It will require RADIUS server with accounts based on the MAC address for each device, which will be authorized to access a WM-AD, and update for all new devices. The second level of authentication requires users' accounts for CP or 802.1x, which are independent from the MAC accounts.

The MAC based authentication can be used for any type of the WM-AD assignment (3rd Party AP Excluded).

In the environment with multiple RADIUS servers, a server may be dedicated to the device authentication, while the other server may be used for the users' authentication, or one server can be used for both levels. The system will allow redundancy on both levels.

Vendor Interoperability

Integration / ST&V testing for the MAC-based authentication will executed with the following platforms in order of priority.

- Newbury Locale Server
- IAS
- FreeRADIUS
- Funk Steel Belted RADIUS & Odyssesy

8 FreeRADIUS and Security

Overview

A good way to get up a running with an inexpensive RADIUS server is to use freeRADIUS. This program is available from www.freeradius.org and provides good options for RADIUS authentication and accounting. While it is possible to configure freeRADIUS to interoperate with a Microsoft infrastructure such as Active Directory using LDAP it is recommended that IAS (Internet Authentication Service) is used for better integration with a Microsoft environment.

For those without a Microsoft infrastructure, or those without a budget, read on.

FreeRADIUS is available as a tarball from the freeRADIUS website and it can be readied for use on most systems with the typical steps:

```
./configure
make
make install
```

As of the writing of this document the current release of FreeRADIUS was 1.0.3. Once it is installed the configuration files are typically found at either /usr/local/etc/raddb or under /etc/raddb. The binary is called radiusd and running the file in the foreground as radiusd -X is very useful for debugging RADIUS requests.

Configuration

The configuration of FreeRADIUS involves modifying several files that usually reside under /usr/local/etc/raddb or /etc/raddb.

radiusd.conf file

The main configuration for FreeRADIUS is within the radiusd.conf file. This file contains general options for how the server behaves, which general protocols to respond to, etc. Here are some notes on the sections that may come in handy:

authorize section

uncomment all auth types that are in use (files is the name of the type that uses the user file).

clients.conf file

This file contains definitions of RADIUS clients that are allowed to interact with the RADIUS server for AAA information.

The simplest format to use is:

```
client 10.0.0.10 {
secret = testing123
shortname = Summit WM001
}
```

In this case the RADIUS client is a Summit WM at 10.0.0.10. Since the Summit WM has many IP addresses, some physical and some virtual, there is confusion over which IP address to use as the RADIUS client address. The answer is that whatever interface the Summit WM will use to send the packet to the RADIUS server. In the CLI of the Summit WM use the ping <target> command to determine which interface will be used if it is not obvious. If the path to the RADIUS server changes based upon OSPF routing updates then it is best to enter all possibilities into this file.

The secret parameter will be asked for during the configuration of the Summit WM WLAN equipment and is typically referred to as the 'shared secret'.

users file

Example for Captive Portal Authentication

The users file is used for entering static information that can be used for authentication. The simplest form of an entry is:

```
"username"  Auth-Type := local, User-Password == "aDRM123"
```

This type of entry can be used for CHAP authentication types. This entry can also be used for PAP-type authentication types provided that the pap definition in the modules section of the radiusd.conf file has the encryption_scheme set to 'clear' rather than the default of 'crypt'.

Attributes can be added to the user definition in this file. An example for a captive portal environment would be:

```
"username"  Auth-Type := local, User-Password == "aDRM123"
Filter-Id = "filter1",
Session-Timeout = 10
```

In this example the filter-id 'filter1' is returned to the Summit WM and a session timeout of 10 minutes is returned. If the Summit WM has a filter defined that matches the returned Filter-Id attribute then it will be used. In addition, if the session is successfully authenticated then the session on the Summit WM has an absolute limit of 10 minutes at which point re-authentication will be necessary.

Example for MAC-based Authentication

Users can also be defined directly as type PAP, for example, for MAC-based authentication the Summit WM sends both the username and the password as the MAC address, so it is typical to see a device entered into the users file as follows:

```
#vocera badge example
"0009EF003BAF" Auth-Type := PAP, User-Password == "0009EF003BAF"
```

To use the Challenge Handshake Access Protocol (CHAP) which prevents the password from ever being transmitted between the Summit WM and the RADIUS server switch the Auth-Type setting to CHAP and change the Auth. Type in the WM-AD settings under the Auth & Acct tab to use CHAP.

```
#vocera badge example
"0009EF003BAF" Auth-Type := CHAP, User-Password == "0009EF003BAF"
```

You may also switch to MS-CHAP or MS-CHAPv2 in the Summit WM and then format the user entry as follows:

```
#vocera badge example
"0009EF003BAF" Auth-Type := MS-CHAP, User-Password == "0009EF003BAF"
```

This type of entry supports both MS-CHAP and MS-CHAPv2 authentication types from the Summit WM.

Note that RADIUS attributes cannot be returned for MAC-based authentication.

Example for 802.1x Authentication

To define a user for PEAP or TTLS authentication where a username/password combination is still required the user can be formatted as:

```
"username"  Auth-Type := EAP, User-Password == "aDRM123"
```

However, this will make this user ONLY useful for EAP connections. Otherwise format the user as Auth-Type 'local' and FreeRADIUS will use the user entry for PAP, CHAP, and EAP auth-type messages.

eap.conf file

For recent versions of FreeRADIUS the configuration of EAP has been moved from the radiusd.conf file into a separate file called eap.conf. If you don't have this file look for these configuration items within the radiusd.conf file itself.

The configuration of EAP support under FreeRADIUS involves the following steps:

1. Generate / Install Certificates
2. Configure eap.conf file

Generate / Install Certificates

In the scripts subdirectory of the FreeRADIUS distribution tarball there is are scripts for creating root, server, and client certificates. It is recommended to get a certificate generated off of a real CA rather than one generated by these utilities since the default action of most wireless clients is to check the certificate being used on the server side against a list of known CAs. Windows' wireless configuration can relax this requirement by deselecting the checkbox for 'Validate server certificate.

For PEAP and TTLS only a server certificate needs to be installed. For TLS both a server certificate and a client certificate generated off the same root certificate needs to be installed.

Configure eap.conf file

The eap.conf file contains general information on the handling of EAP packets that are forwarded to the RADIUS server. We will cover the configuration of the file for TLS and for PEAP.

For TLS or PEAP the TLS section needs to be completed. This is because even with PEAP authentication types a secure tunnel is needed from client to server and the TLS section contains the information required to set this tunnel up. Consider the following configuration file listing:

Figure 17: Example eap.conf file

```
eap {
      tls {
            private_key_password = whatever
            private_key_file = ${raddbdir}/certs/cert-srv.pem
            certificate_file = ${raddbdir}/certs/cert-srv.pem
            CA_file = ${raddbdir}/certs/demoCA/cacert.pem
            dh_file = ${raddbdir}/certs/dh
            random_file = ${raddbdir}/certs/random
            fragment_size = 1024
            include_length = yes
            #check_crl = yes
            #check_cert_cn = %{User-Name}
      }
      peap {
            default_eap_type = mschapv2
      }
      mschapv2 {
            }
}
```

The TLS section contains pointers to the server certificate file(s) provided from your Certificate Authority. With the minimal setup shown above (and the properly installed certificates) both TLS and PEAP are active.

Debugging FreeRADIUS

```
radiusd -X
radtest
```

9 RADIUS Attributes

Remote Authentication Dial-In User Service (RADIUS) is an industry standard for providing identification, authentication, authorization, and accounting services for distributed dial-up/remote access networking.

RADIUS Vendor-Specific Attributes (VSAs)

RADIUS Vendor-Specific Attributes (VSAs) are RADIUS Authentication and Accounting attributes defined by vendors to customize information exchanges between clients and servers. This allows unique behaviors to be implemented in client applications without requiring custom server development. VSA support is included directly in dictionary files distributed with RADIUS server products (for example, Funk Steel Belted RADIUS), or can be configured manually on most server products.

Table 9 defines the Extreme Networks VSAs currently implemented in the Summit WM series switch, access points, and WLAN switch software solution, defined using the Extreme Networks Organizationally Unique Identifier (OUI):

Table 9: Extreme Networks VSAs

Attribute Name	ID	Type	Messages	Description
Extreme-URL-Redirection	1	string	Returned from RADIUS server	A URL that can be returned to redirect a session to a specific Web page.
Extreme-AP-Name	2	string	Sent to RADIUS server	The name of the AP the client is associating to. It can be used to assign policy based on AP name or location.
Extreme-AP-Serial	3	string	Sent to RADIUS server	The AP serial number. It can be used instead of (or in addition to) the AP name.
Extreme-WM-AD-Name	4	string	Sent to RADIUS server	The name of the WM-AD the client has been assigned to. It is used in assigning policy and billing options, based on service selection.
Extreme-SSID	5	string	Sent to RADIUS server	The name of the SSID the client is associating to. It is used in assigning policy and billing options, based on service selection.
Extreme-BSS-MAC	6	string	Sent to RADIUS server	The MAC address of the BSS-ID the client is associating to. It is used in assigning policy and billing options, based on service selection and location.

RADIUS Accounting

Account-Start Packet

Table 10 lists the information elements (including VSAs) supported in a RADIUS Start message, issued by Summit WM series switch, access points, and WLAN switch software, with RADIUS Accounting enabled:

Table 10: Information elements supported in RADIUS Start messages

Attribute	NO.	RAD. Data Type	Name
Acct-Session-Id	44	string	mu_session_id
User-Name	1	string	mu_user_id
Filter-Id	11	string	Filter-Id (Accept-response)
Acct-Interim-Interval	85	integer	(Accept-response/GUI input)
Session-Timeout	27	integer	(Accept-response/GUI input)
Class	25	octets	(Accept-response)
Login-LAT-Group	36	octets	(Accept-response)
Acct-Status-Type	40	integer	Start
Acct-Authentic	45	integer	Radius/Local/Remote
Framed-IP-Address	8	ipaddr	Mu_ip_address
Connect-Info	77	string	802.11 a or 802.11 a/b
NAS-port-type	61	integer	18/19
Called-Station-ID	30	string	BP MAC
Calling-Station-ID	31	string	mu_mac_address
NAS-IP-Address	4	ipaddr	User configurable
NAS-Identifier	32	string	User configurable
Acct-Delay-Time	41	integer	
BP-Serial	VSA	string	Extreme-AP-Serial
BP-Name	VSA	string	Extreme-AP-Name
WM-AD-Name	VSA	string	Extreme-WM-AD-Name
SSID	VSA	string	Extreme-SSID

Account-Stop/Interim Packet

Table 11 lists the information elements (including VSAs) supported in a RADIUS Stop or Interim messages, issued by Summit WM series switch, access points, and WLAN switch software, with RADIUS Accounting enabled:

Table 11: Information elements supported in RADIUS Stop or Interim messages

Attribute	NO.	RAD. Data Type	Name
Acct-Session-Id	44	string	mu_session_id
User-Name	1	string	mu_user_id
Filter-Id	11	string	Filter-Id (Accept-response)

Table 11: Information elements supported in RADIUS Stop or Interim messages (Continued)

Attribute	NO.	RAD. Data Type	Name
Acct-Interim-Interval	85	integer	(Accept-response/GUI input)
Session-Timeout	27	integer	(Accept-response/GUI input)
Class	25	octets	(Accept-response)
Login-LAT-Group	36	octets	(Accept-response)
Acct-Status-Type	40	integer	Stop/Interim-Update
Acct-Terminate-Cause	49	integer	Termination code (only in stop packet)
Acct-Authentic	45	integer	Radius/Local/Remote
Framed-IP-Address	8	ipaddr	Mu_ip_address
Connect-Info	77	string	802.11 a[b][g]
NAS-port-type	61	integer	18/19
Called-Station-ID	30	string	BP MAC
Calling-Station-ID	31	string	mu_mac_address
Acct-Delay-Time	41	integer	
Acct-Session-Time	46	integer	
Acct-Input-Packets	47	integer	
Acct-Output-Packets	49	integer	
Acct-Input-Octets	42	integer	
Acct-Output-Octets	43	integer	
BP-Serial	VSA	string	Extreme-AP-Serial
BP-Name	VSA	string	Extreme-AP-Name
WM-AD-Name	VSA	string	Extreme-WM-AD-Name
SSID	VSA	string	Extreme-SSID

Termination Codes

The RADIUS client (Summit WM series switch or AP) terminates the wireless device user's session when one of the following events occur:

- user request
- idle timeout
- session timeout
- administrator reset

When a user session is terminated, the RADIUS client sends a RADIUS accounting stop request that will include one of the following termination codes:

Table 12: Termination codes

Radius Value	Radius Definition	Controller Value	Controller/SMT Definition	Controller Name
1	User Request	9	RF notification that MU has disconnected from Altitude AP. This would be the case if there is a Logoff button for Captive Portal. Normally this would not apply to 802.1x connections.	MU_DEREG_REASON_USER_REQUEST
4	Idle Timeout	1	User has been disconnected due to idle timeout and inactivity	MU_DEREG_REASON_IDLE_TIMEOUT
5	Session Timeout	7	Disconnection as a result of the maximum session length value indicated by RADIUS server upon Access-Accept, or defined as a default value for the WM-AD.	MU_DEREG_REASON_LIFETIME_TIMEOUT
6	Admin Reset	2 3 8	Explicit request by Management infrastructure (GUI user) to disconnect MU	MU_DEREG_REASON_RF_DICONNECT MU_DEREG_REASON_ADMIN_REQ MU_DEREG_REASON_TUNNEL_DISCONNECT
11	NAS Reboot		BM graceful shutdown	N/A
17	User Error		Unknown reason	N/A

Supported attributes in RADIUS authentication and RADIUS response messages

Table 13 provides a list of the attributes supported in RADIUS authentication and RADIUS response messages.

Table 13: Supported attributes in RADIUS authentication and RADIUS response messages

	MBA on SSID WM-AD	MBA on AAA WM-AD	AAA WM-AD	SSID WM-AD CP Auth (MSCHAP)	SSID WM-AD CP Auth (CHAP)	SSID WM-AD CP Auth (PAP)
Attributes from Radius Server						
Termination-Action	X	X	Y	X		
Login-Lat-Group	Y	X	Y	Y		
Filter-ID	Y	X	Y	Y		
Class	X	Y	Y	Y		
Session-Timeout	Y	Y	Y	Y		

Table 13: Supported attributes in RADIUS authentication and RADIUS response messages (Continued)

	MBA on SSID WM-AD	MBA on AAA WM-AD	AAA WM-AD	SSID WM-AD CP Auth (MSCHAP)	SSID WM-AD CP Auth (CHAP)	SSID WM-AD CP Auth (PAP)
Login-Lat-Port (auth_state)	Y	X	NA	NA		
Acct-Interim-Interval	X	Y	Y	Y		
Tunnel-Private-Group_ID	X	X	Y	X		
MS-MPPE-Recv-Key	NA	NA	Y	NA		
MS-MPPE-Send-Key	NA	NA	Y	NA		
VSAs from Radius Server						
redirection_url	Y	X	NA	Y	Y	Y
Attributes to Radius Server						
User name	Y (ETH-MAC)	Y (ETH-MAC)	Y	Y	Y	Y
BSS-MAC	Y	Y	Y	Y	Y	Y
NAS-IP-Address	Y	Y	Y	Y	Y	Y
NAS-Port	Y	Y	Y	Y	Y	Y
NAS-Port-Type	Y	Y	Y	Y	Y	Y
NAS-Identifier		Y	Y	Y	Y	Y
CHAP-Password	Y (CHAP)	Y (CHAP)	X	X	Y	X
User-Password	Y (PAP)	Y (PAP)	X	X	X	Y
MS-CHAP-Challenge	Y (MSCHAP)	Y (MSCHAP)	X	Y	X	X
MS-CHAP-Response	Y (MSCHAP)	Y (MSCHAP)	X	Y	X	X
Framed MTU			Y			
Called-Station-ID			Y			
Calling-Station-ID			Y			
EAP-Message			Y			
Message-Authenticator			Y			
VSA to Radius Server						
BP-Name	X	X	Y	Y	Y	Y
BP-Serial	X	X	Y	Y	Y	Y
WM-AD-Name	Y	Y	Y	Y	Y	Y
SSID	X	X	Y	Y	Y	Y
BSS-MAC	Y	Y	Y	Y	Y	Y

X= No Y= Yes N= Not Applicable

10 SNMP MIBs

Summit WM series switch is the main repository of all configuration and statistical data for itself and all Altitude APs, WM-ADs and attached Mobile Units. SNMP is one of the user interfaces to retrieve such information.

For retrieval of such information, Summit WM series switch supports a subset of MIB-II, as well as proprietary MIBs. In implementation of standard MIBs, all Altitude APs and their interfaces are presented as extensions of the Summit WM series switch, as if they are physical interfaces of the Summit WM series switch. Each WM-AD is also presented as one of the interfaces of Summit WM series switch. The supported MIBs are:

- IF-MIB
- RFC1213
- SNMPv2-MIB
- IEEE802dot11-MIB
- EXTREME-SUMMIT-WM-DOT11-EXTS-MIB
- SUMMIT-WIRELESS-PRODUCT-MIB
- EXTREME-SUMMIT-WM-MIB.my
- EXTREME-SUMMIT-WM-BRANCH-OFFICE-MIB

IF-MIB

Summit WM series switch supports ifTable and ifXTable tables in this MIB. These tables return information about all physical interfaces of Summit WM series switch as well as WM-ADs as interface objects and Altitude AP interfaces. The description of each interface helps identify the interface object.

For example, WM-AD interface description is the name of the WM-AD and each Altitude AP has three interfaces—one wired and two radio. The wired interface of theAltitude AP is named by concatenation of the Altitude AP serial number and word "_ethernet" and each radio interface is named by concatenation of the Altitude AP serial number and the radio type. The following are examples of some of the interfaces with arbitrary indices.

- Some of the physical ports of the Summit WM series switch:

  ifDesc.1 = esa0

  ifDesc.2 = esa1
- WM-AD by the name "roaming":

  ifDesc.7 = roaming
- Altitude AP with serial number 1122334455667788 (assuming the arbitrary indices of 100, 101 and 102):

  Wired interface: ifDesc.100 = 1122334455667788_ethernet

  802.11b/g radio: ifDesc.101 = 1122334455667788_802.11b/g

  802.11a radio: ifDesc.102 = 1122334455667788_802.11a

Interfaces are numbered starting from Summit WM series switch's physical ports, with the exception of eth1 interface that is indexed at 99, then WM-AD interfaces and finally Altitude AP interfaces. Summit WM series switch physical interfaces are numbered from one, (for example esa0, esa1, esa2) with indices 1, 2, 3 respectively. The exception is the management port eth0 which is numbered 99.

WM-AD indices begin following the esaXX ports. Altitude AP interface numbering begins following the WM-ADs and the first Altitude AP wired interface is given the lowest interface number starting at 100. Each radio occupies the next indices (For example, 101 for radio B/G and 102 for radio A). The next Altitude AP and its interface occupy the next available interface number.

RFC1213

This MIB is fully supported and Summit WM series switch's system related information can be obtained through this MIB. Other information such as IP address of interfaces, SNMP stats or IP routing are retrievable through this MIB as well.

IEEE802dot11-MIB

Summit WM series switch supports the following tables/groups defined in this MIB:

- dot11StationConfigTable
- dot11PrivacyTable
- dot11OperationTable
- dot11CountersTable
- dot11res.dot11resAttribute
- dot11PhyOperationTable
- dot11RegDomainsSupportedTable
- dot11SupportedDataRatesTxTable
- dot11SupportedDataRatesRxTable.

Proprietary MIBs

Our proprietary MIBs can be used to retrieve useful information about the system as a whole.

EXTREME-SUMMT-WM-MIB.my

The main groups and tables defined in this MIB are:

- **systemObects** – The types of information that can be retrieved from this group includes software and hardware information, information of physical interfaces, DNS information, and tunneling information.
- **virtualNetworks** – This group provides us all details information about all configured WM-ADs and their attributes such as IP addresses, Radius information, and DHCP.

- **accessPoints** – This group provides information about all Altitude APs and their attributes.
- **mobileUnits** – This group provides information about mobile units associated with the Summit WM series switch.
- **association** – Provides statistics about mobile units attached to the Summit WM series switch.

EXTREME-SUMMIT-WM-DOT11-EXTS-MIB

This MIB complements the IEEE802dot11-MIB in retrieving configuration or statistical information proprietary to Summit WM series switch. Some example of such information include:

- Mobile unit association information (assocGroupTable and assocCountersTable).
- SSID can be accessed through the dot11ExtBSSIDTable.

EXTREME-SUMMIT-WM-WIRELESS-PRODUCT-MIB

This MIB contains object identifier (OID) for Summit WM Wireless products.

EXTREME-SUMMIT-WM-BRANCH-OFFICE-MIB

Branch office information can be obtained using this MIB.

11 DRM - Dynamic Radio Management

Introduction

WLANs are becoming more common. Usage has grown to require higher user capacities and higher radio frequency (RF) density. As 802.11 becomes standard for larger networks, network performance becomes a critical factor in managing the network.

A Site Survey is necessary for installing and configuring large WLAN networks. However Site Surveys are not sufficient in addressing how the WLAN network will perform over time.

The performance of an 802.11 network depends on how many clients are sharing the network. Larger numbers of clients require a denser deployment of AP's. However as AP's are packed into a smaller area, they interfere with each other and reduce the overall performance of the network.

Performance also depends on propagation of RF signals. RF signal propagation is affected by other Access Points, people, and other objects in the coverage area. The RF propagation changes as people and objects move through the coverage area. Wireless Access Points and Stations have to constantly adapt to the changing RF environment – generally dropping the connection rate in noisier environments.

The purpose of RF Management is to dynamically adapt the AP configuration (in most cases, the transmit power) to changing environmental conditions.

When deploying dense WLAN networks, network administrators face two main challenges:

- dense deployment causing RF interference with neighboring access points residing on the same or neighboring channels, and;
- RF interference and impedance from changing environments such as the movement of people, the position of objects in the office, as well as other RF technologies such as Bluetooth, microwave, or other cordless technologies.

Co-Channel Interference in Dense Deployments

As WLAN installations become more critical to the business infrastructure, they need to be engineered to address larger numbers of users and better coverage. In these cases, WLAN installations require more Access Points installed in closer proximity. A dense deployment requires coordinated channel selection and power management among the APs.

As APs are deployed in dense environments with overlapping RF coverage, it is impossible to avoid co-channel interference between APs on the same channel. Co-channel interference causes collisions between RF data transmissions, which reduces effective throughput. In Voice over WLAN applications, co-channel interference increases jitter and latency, which can result in audible static during conversations. For example, co-channel interference is more common in the 2.4 GHz band (802.11b and 802.11g) where there are only 3 non-overlapping channels (1, 6, and 11) in North America.

Other sources of RF Interference

RF quality can also be affected by interference caused by other RF technologies and propagation characteristics of the RF signal through and around objects.

Other devices operating in either the 2.4 GHz band or the 5GHz band can interfere with 802.11 data transmission. These types of devices include equipment such as fluorescent lights, other wireless technologies such as Bluetooth or cordless phones. Microwave equipment including microwave ovens can interfere in different ways with 802.11 devices depending on how they use the RF spectrum.

An RF transmission through any object will cause interference in the form of reflection and refraction. The amount of reflection or refraction will depend on the geometric and material properties of the object. Metal objects will tend to reflect the signal, while wood, concrete, or water will tend to absorb and refract (bend) the signal.

Refraction generally causes loss in signal power, while reflection causes a change in signal direction. Refraction will cause a device to receive a signal at a reduced power level, thereby reducing the signal-to-noise ratio (SNR). A large power reduction can cause the 802.11 client to lose data and potentially its link to the Access Point.

Signal reflection can cause the wireless device to receive the same signal (or data packet) at a small time delay. This multi-path interference can cause data transmission errors and if significant, can cause a wireless device to lose its link with the Access Point.

The changes to the RF environment will occur dynamically. In the simplest case, people walking around an office or doors being open or shut can change in the RF coverage. Most industries are prone to dynamic RF changes, but some can be critically prone, such as:

- Hospitals – lots of body movement and equipment movement, including lead-lined curtains
- Education – students (people) – the number one source of absorption
- Public places – caused mostly by people, but include indoor signage from stores, mobile kiosks, booths for convention centers, other wireless devices not controlled by the network administrator, etc.
- Warehousing – addition and removal of inventory, and the equipment used to move the inventory

DRM Benefits

RF Management with DRM allows the Altitude APs to exchange RF information and dynamically adapt to changes in the RF environment. It allows the WLAN to be installed in dense deployments while avoiding interference issues.

DRM provides additional benefits which include:

- Highest available RF data rate. With the smart exchanges between Altitude APs, the WLAN ensures the highest performance for the entire wireless network.
- RF redundancy. With a dense deployment, DRM provides dynamic redundancy when a Altitude AP fails (e.g. power loss); Altitude APs can detect the loss of an adjacent Altitude AP and therefore increase coverage dynamically to eliminate “dead spots”.

- Operational savings. With RF management, network administrators do not need to plan out the channel assignment and the signal strength for every Altitude AP. Also, with a dense deployment, site surveys are no longer obligatory.
- Dynamic client load balancing across Altitude APs for Dynamic Radio Management (DRM) client software.
- Advanced features:
  - Co-existence with Rogue AP Detection (Summit WM series spy) feature
  - Load balancing even across multi-subnetted HAPs
  - Interaction with other APs to reduce co-channel interference. DRM can be configured to avoid co-channel interference with neighboring WLANs.

DRM Details

DRM provides dynamic RF management and channel selection upon boot up, maximizing the performance of the WLAN. DRM mitigates the need for extensive and costly site surveys when simple coverage is not the only requirement.

DRM Power Control

DRM provides two methods of power control for the enterprise. They are called Standard Power control and Shaped power control. Both methods provide the best possible service while minimizing interference between APs operating on the same channel.

The following sections describe the two power control modes.

DRM Standard Power Control

DRM Standard RF Power Control provides the best possible service to wireless clients while minimizing interference between APs operating on the same channel. DRM Standard Power Control dynamically adjusts power to service the furthest client from the AP. DRM creates a consistent footprint of the cell while minimizing the traffic present over the entire cell. This feature provides the basis for clients (PCs or WiFi handsets) to accurately determine when to roam from AP to AP.

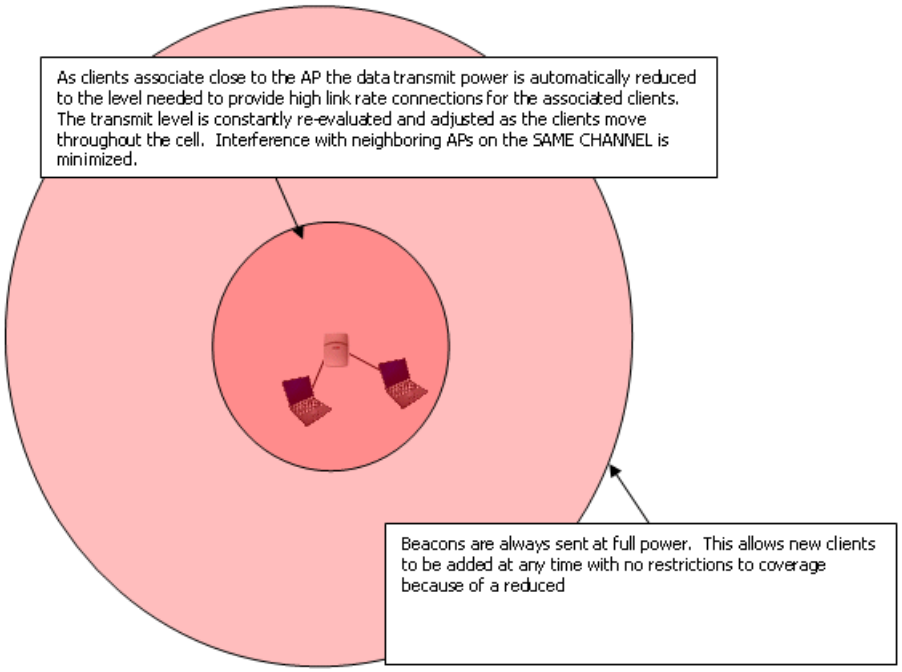
The goal of DRM RF Power control is to provide the best possible service to clients associated with the AP. With the increasing number of 802.11 devices present in the market, and the limited number of channels to choose from, it is critical for APs to limit their transmit range to the maximum required to service its clients. Limiting this range maximizes the ability to reuse channels. This feature then maximizes the number of 802.11 transmitting devices that can successfully operate in an environment.

The following sections describe how DRM Standard RF Power Control works.

Maximizing RF Footprint

DRM Standard Power Control transmits 802.11 management frames at full power creating a maximum sized RF cell. Management frames include Beacons, Association and Disassociation frames, and Probe request and responses. Clients use these messages to evaluate the RF environment, establish connections to APs, and determine when to roam to a new AP. All of these operations are critical to the operation of a wireless client.

Figure 18: DRM Standard Power Mode



The diagram in Figure 1 shows clients at different distances from the AP. Both clients measure the signal strength from the AP using Beacons or Probe Responses. This gives the client and accurate view of the RF signal quality it can obtain from the AP.

Minimizing interference

Data traffic in a wireless network makes up the majority of transmissions causing interference. A client associated to an AP that is very close does not need the AP to transmit at full power in order to obtain a great connection. Reducing power of the data traffic not only provides excellent performance to the client but also reduces the amount of interference this traffic may cause to other APs.

DRM continuously monitors the position of its clients and dynamically adjusts power to accommodate the furthest client. In the diagram shown in Figure 2, the transmit power for data frames is raised to support the client furthest away.

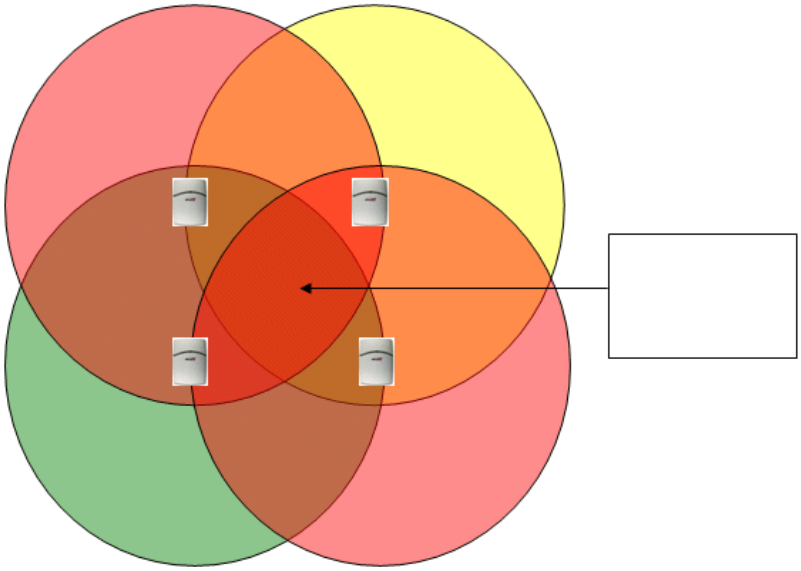
The diagram in Figure 1 shows the inner ring (data frame transmit power) reaching just past the furthest client. Transmitting at a power level that provides the furthest client with the best service yields the best overall system performance.

If the furthest client moves closer to the AP or roams to another AP, DRM will automatically adjust the power to provide the best results for the changing environment.

Clients that are continuously moving (WiFi phones for example) require an RF environment that will adapt quickly to its needs. DRM monitors every client for movement and accurately adjusts power to support them. This process is done continuously to support all clients whether stationary or moving.

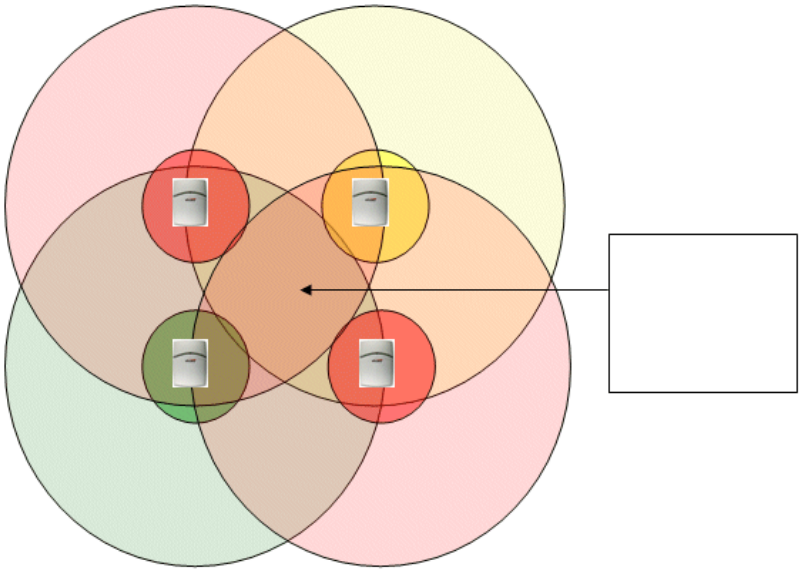
Now consider this deployment for a system of 4 APs deployed in a region where there are only 3 non-overlapping channels such as America.

Figure 19: Non DRM APs and area of co-channel interference



When APs are deployed to cover an area a minimum average data rate is generally required by the customer. However, when APs are deployed to ensure this rate everywhere the area covered by then entire cell must be considered. This is shown above. Since channel 1 is repeated within close proximity of another channel 1 AP there is no choice but to have an area of co-channel interference. This means that the area in the middle of the APs is compromised for the users of either channel 1 AP. Depending on the load level of each AP this area will experience reduced bandwidth due to collisions and other inefficiencies when sharing channels.

Figure 20: Reduction of co-channel interference using DRM-enabled APs



Now consider the case for DRM's standard RF mode. The data Tx range from each AP is kept as low as possible give the active clients. The area of co-channel interference in the middle of the APs is now reduced to just co-channel interference for beacons. Beacons are regular traffic but are only sent on a typical interval of every 0.1 seconds. Also, for co-channel interference from beacons to occur in the center area the beacons from the co-channel APs would have to be exactly synchronized. Given the infrequency of the beacons and the probability of an exact synchronization between co-channel APs then it is fair to say that the dynamic RF ability of DRM's standard mode helps significantly clean up the co-channel interference in the center of this example diagram.

Supporting New Clients

A key characteristic of DRM Power control is how it handles new clients. When a client first associates, DRM increases the transmit power for data frames to full power. This is done because DRM does not know the status of the client when it first associates. DRM then evaluates the clients needs and adjusts the transmit power to support it. If the client is far away, DRM provides more power to support it. If the client is very close, the transmit power for data traffic is reduced significantly to minimize interference.

RF Domain

DRM adjusts power to APs that are part of its network. Another AP is defined as being part of this network if the SSID matches the SSID of this AP. If the APs support multiple SSIDs, then the APs are considered part of the same network if any of the SSIDs match.

If APs are configured to suppress their SSIDs, none of the APs can determine which APs are part of the same network. To overcome this issue, DRM has introduced the concept of an RF Domain. The RF Domain creates a set of APs that are part of the same wireless network. To establish an RF Domain, each AP that is to be included must have a new field added to its configuration, the RF Domain. This field is

a text string that is transmitted with each 802.11 Summit. Clients can't use this information to associate or compromise security. Its purpose is to create a set of APs that DRM will include in its power control adjustments.

DRM Shaped Power Control

DRM provides a second enterprise class power control mode called Shaped Power Control. In this mode, DRM APs will reduce power to minimize interference between other APs operating on the same channel. When DRM reduces power in this mode, it reduces power of all 802.11 frames including the management frames. This shrinks the size of the cell for both management and data frames.

This mode does not adjust the power to provide better service to distant clients. If a client moves to a position that provides marginal service from the AP it is associated to, DRM assumes that the client will realize this and roam to a better AP.

This mode assumes that there are enough APs in the environment to provide excellent service at any location.

It is important to make sure that the APs configured for this mode are operating on the same plane as the clients. The APs are adjusting power to avoid interfering with each other and are not taking into account the location of clients. If the APs are mounted on high ceilings (For Example: 50 feet above an exhibit hall floor) and the APs reduce power to avoid interfering with other APs, the coverage on the exhibit hall floor may be severely impacted.

The trade-off for using Shaped Power Control vs Standard Power Control is whether increasing the transmit power for data frames to support distant clients will impact the performance of neighboring APs operating on the same channel. How well Shaped Power Control will work depends on the type of client. Experience has found that for most situations, Standard Power Control provides the best service to clients, particularly WiFi phones.

DRM Power Control Summary

- DRM Standard Power Control transmits management frames a full power creating a full size cell that clients use to analyze the environment.
  - This provides a consistent view of the RF environments to all clients
  - Clients can make accurate association decisions
  - Clients will know exactly when they should roam to a new AP
- DRM Standard Power Control Reduces the Transmit power of Data frames if there are other APs present in the environment operating on the same channel.
  - Reducing the transmit power of data frames minimizes co-channel interference
  - And increases the ability to reuse channels
- DRM Standard Power Control Continuously monitors this situation and will raise power if the other AP is removed from service, changes channel, or fails
  - DRM provides the best possible service to a changing RF environment
- DRM will lower power if a new AP is brought online on the same channel in its environment.

- When clients associate, DRM Standard Power raises the transmit power of data frames to the maximum, monitors the position of the client, and then adjusts the transmit power to provide the best possible service.
- When client movement is detected, DRM Standard Power Control will increase data frames to full power, reevaluate the position of the client, and adjust power again to best service the client.
- DRM Continuously monitors and adjusts the transmit power for data frames to accommodate a very dynamic RF environment.
- The results of DRM RF Power Management are
  - Minimized interference
  - Maximum performance for clients
  - Maximized ability to reuse channels
  - Overall better system performance
- DRM Shaped Power Control reduces the transmit power of all 802.11 frames including management frames
  - This shrinks the entire cell minimizing interference with other APs
- DRM Shaped Power Control does not adjust power to support distant clients
  - Once the Cell size is established, client associations do not affect it
  - DRM Shaped Power control will adjust the cell size when new APs are brought online or removed from service
- DRM Shaped Power Control minimizes the co-channel interference between APs.

DRM Automatic Channel Selection

When DRM is enabled for both the Summit WM and for a specific AP then the access point may then participate in a dynamic channel selection procedure. If a radio within the AP is configured to use a channel called 'auto' then the automatic channel selection procedure occurs under the following conditions:

- At boot time of the AP,
- When DRM is enabled globally for the system,
- When DRM is enabled for a specific AP, and
- When the 'ReSync DRM' button is selected from the UI.

The DRM channel selection algorithm automatically selects channels to minimize interference and optimize performance. The algorithm requires no central authority and works equally well in both sparse and dense deployments. DRM devices work in concert with each other selecting the best possible channel and cell size for any environment.

The DRM channel selection algorithm has the following properties

- fully distributed
- requires no central authority
- scales infinitely
- Accounts for non-DRM devices as well as DRM devices

- Compliant to all 802.11 standards
- Requires no connections between APs (i.e. only the APs that can hear each other participate in the process)

The channel selection process has several phases:

- Scanning (localized site survey)
- Selection (pick the best channel)
- Negotiate (request to operate on the selected channel)
- Operate (begin operation on the channel selected)

Scanning Phase

During the scanning phase, each AP scans all of the channels available in the regulatory domain. The APs search for other APs already operating on the channel, determine their signal strength, and locate other sources of non-802.11 interference. This information is used to determine the best channel for this AP to operate on.

In addition to listening for existing devices operating on the channel, the DRM APs notify other DRM APs that they are in the process of selecting a channel. This serves the following purpose:

- Synchronize all DRM APs during the channel selection process (only applies to situations where all APs are booting at the same time such as after a power failure).

Once the data is collected about existing APs operating on all channels in the environment and other DRM APs that are booting, DRM APs move onto the Selection phase.

Selection Phase

This phase determines the best channel to operate on. In DRM Version 1.0, the algorithm scans the information obtained in the scanning phase looking for the loudest transmitting device on each channel. The result is a list similar to the following:

```
Channel 1:      -32dSummit
Channel 6:      -50dSummit
Channel 11:     -29dSummit
```

Each channels loudest signal is captured. These signals are scanned and the channel with the quietest signal is selected. In the example above, Channel 6 would be selected because -50dSummit is the weakest signal.

The selection process for DRM Version 1.2 is quite a bit more sophisticated. The information obtained in the scanning phase is fed into an algorithm to create a Channel Quality Index (CQI). The channel with the lowest CQI is then selected as the best channel. The CQI is computed using the following information:

- Loudest transmitting device operating on a channel
- Noise floor of the channel

- Other transmitting devices on the channel
- Transmitting devices on neighboring channels
- Transmitting devices on overlapping channels (Turbo-channels)

The CQI value is designed to take into account all forms of possible interference on a particular channel. If the noise floor is high on a channel, that channel's CQI is adjusted to look proportionally worse than a channel with no noise. If there are transmitters operating on adjacent channels, the overlapping channels CQI is adjusted to take this into account.

Each channels CQI is computed and the channel with the lowest CQI is chosen as the best channel.

Negotiation Phase

Once the channel has been selected (either using the V1.0 method or the V1.2 method), the negotiation process begins. The purpose of this process is to give the requested channel to the AP that needs it most. APs in dense areas get priority over other APs.

During the negotiation process, DRM APs communicate their selected channel and information about their denseness situation over the selected channel. The negotiation period lasts long enough for all APs that have selected the same channel to receive all of the other APs channel selection information. Once the negotiation period expires, all the APs determine if they are allowed to operate on the selected channel. The AP with the greatest need is allowed to operate on the selected channel. All other APs return to the scanning phase.

The APs that return to the scanning phase perform a minimal scan to detect any new APs operating on a channel. These are typically the APs that have just won the negotiation process. The channels are evaluated once more and the best channel is selected. A new negotiation round begins for this AP.

Operation Phase

Once an AP succeeds in acquiring its selected channel, it makes a quick check of that channel to make sure that nothing has changed during the negotiation process (i.e. a new AP appears nearby on the channel changing the CQI or Signal Strength measurement for that channel). If everything looks ok, the AP enables the channel and begins operation.

Channel Selection Time

The amount of time it takes to perform the first round of channel selection is approximately 60 seconds.

NOTE

This number assumes that the regulatory domain does not require radar detection. For regulatory domains requiring radar detection, each pass though the negotiation phase requires a radar check that lasts 60 seconds. This significantly impacts the channel selection time for the 802.11a band due to the number of available channels. In an 802.11a environment with 19 channels and 17 APs, it can take 30 minutes to complete channel selection. Extreme Networks is working on solutions to improve this time.

APs that lose the negotiation phase return to the scanning phase. A new scan takes approximately 15 seconds after which a new round of negotiating takes place.

The distributed nature of this algorithm results in an optimum distribution of channels over a large number of APs. The maximum amount of time required to select channels is approximately 3 minutes. In a large and dense deployment of APs, many groups of APs pick channels simultaneously. Each round causes more and more APs to select appropriate channels in parallel. Even in dense deployments, an AP will acquire the selected channel after approximately three rounds of negotiating

Management

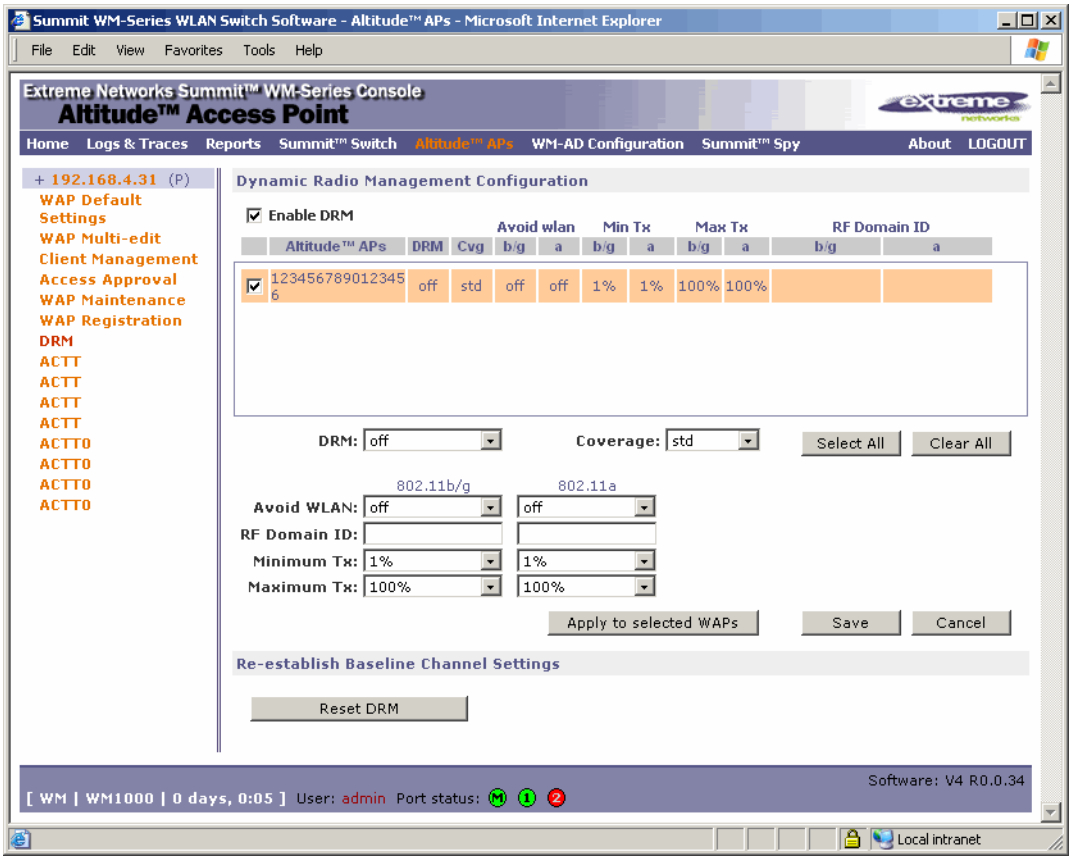
DRM is configured and monitored centrally. The configuration of DRM consists of:

1. enable/disable DRM – global and per Access Point settings
2. group DRM configuration
3. enable/disable the avoidance of other WLANs
4. override channel assignment
5. Restart DRM (resetting of channel and power).
6. Type of shaped coverage (standard versus shaped)
7. Max/Min RF power configuration

When DRM is enabled, both channel and transmit signal strength are automatically configured by DRM. Upon power-up, DRM will scan the WLAN network to select a channel and set its power to maximum. It will back-off its power to adjust for the presence of neighboring disabled DRM Access Points.

The DRM application is enabled globally on the Summit WM. This means that a Summit WM with the DRM software key will enable DRM on all APs with R2.1 or higher software. It is also possible to configure DRM on a per AP basis. Figure 3 shows the configuration page when DRM is enabled via software keys.

Figure 21: DRM global settings



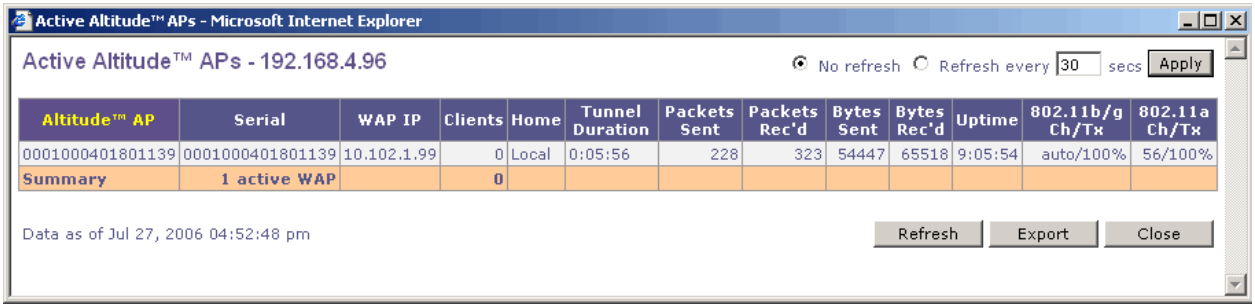
This page allows the parameters of DRM to be configured for the entire system. The following settings are available:

- **Enable DRM** – controls whether DRM is enabled or disabled for the entire system. This setting overrides the setting on each individual AP.
- **DRM on/off** – controls whether DRM is enabled or disabled for a specific AP.
- **Coverage** – controls the selection of Standard or Shaped coverage mode for each AP.
- **Avoid WLAN** – controls whether Tx power is backed off in the presence of other WLAN networks that are NOT part of the Summit WM system (i.e. different SSID).
- **Minimum Tx** – allows the user to set the absolute minimum Tx level the AP will use.
- **Maximum Tx** – allows the user to set the absolute maximum Tx level the AP will use.

Reporting

The Summit WM provides dynamic display of channel and transmit power setting for each radio on the AP. Refer to Figure 22.

Figure 22: Altitude AP statistics GUI



12 Logs and Events

The Summit WM series switch is designed to behave like an appliance. It is either in an operational state, or it has failed due to a hardware problem or low level packet processing issue. In general, the system will self recover by rebooting if the system fault is recoverable.

There are two main monitoring processes in the system:

- a hardware watchdog
- a software watchdog

The software watchdog restarts stalled or failed processes, while the hardware watchdog causes system reboot should the software watchdog fail. The result of this approach is that little intervention is required once the system is properly configured and operational.

STARTUP_MANAGER (0)

Table 14: STARTUP_MANAGER (0) logs and events

Log ID	Log Message	Comment	Action
Critical			
2	Failed attempting to start router ports. System reboot initiated.	Internal communication problem. Possible misconfiguration of system.System will Restart	If problem persists, contact Technical Support to investigate.
3	Internal connection to router ports lost. Restart initiated.	Internal communication problem. Possible misconfiguration of system. System will restart.	If problem persists, contact Technical Support to investigate.
4	HSM failed to start. System reboot initiated.	Internal communication problem. Possible misconfiguration of system. System will restart.	If problem persists, contact Technical Support to investigate.
5	HSM is down. System reboot initiated	Internal communication problem. Possible misconfiguration of system. System will restart.	If problem persists, contact Technical Support to investigate.
6	HSM failed to reply to status notification. System reboot initiated.	Internal communication problem. Possible misconfiguration of system. System will restart.	If problem persists, contact Technical Support to investigate.
7	Failed to connect to Langley. System reboot initiated.	Internal communication problem. Possible misconfiguration of system. System will restart.	If problem persists, contact Technical Support to investigate.

Table 14: STARTUP_MANAGER (0) logs and events (Continued)

Log ID	Log Message	Comment	Action
Major			
9	Unable to start component [%d]. Services provided by the component will be unavailable.	Internal component problem.	If problem persists, contact Technical Support to investigate.
20	Component [%d] is down. Component will be restarted.	Internal component became inactive. Component will restart.	If problem persists, contact Technical Support to investigate.
21	Component [%s] is down. Component will be restarted.	Internal component became inactive. Component will restart.	If problem persists, contact Technical Support to investigate.
Minor			
33	Process/component [%d] restarted.	Inactive component has been re-activated. In general re-activation occurs within 1 s.	None
Info			
65	Component [%d] started as part of normal start-up.	Normal system operation	None
66	Component [%d] stopped due to end-user request.	Feature configuration change has caused a component to restart.	None
67	System shutdown requested by Web/CLI.	Administrator has requested system shutdown	None
68	System reboot requested by Web/CLI.	Administrator has requested system shutdown	None
69	Connected to Event Server - event logging starts.	Normal system operation	None
71	Service [%s] is being restarted.	n/a	None

EVENT_SERVER (1)

Table 15: EVENT_SERVER (1) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	Failed to create thews thread.	Internal Component Failure. Log system may not be working properly.	If problem persists, contact Technical Support to investigate.
2	Critical internal error - log file protection flags have been corrupted. Event server will halt.	Internal Component Failure. Log system may not be working properly.	If problem persists, contact Technical Support to investigate.
3	Internal system interrupt handlers failed to initialize. Event server will halt.	Internal Component Failure. Log system may not be working properly.	If problem persists, contact Technical Support to investigate.
4	Unable to initialize internal program thread. Event server will halt.	Internal Component Failure. Log system may not be working properly.	If problem persists, contact Technical Support to investigate.

Table 15: EVENT_SERVER (1) logs and events (Continued)

Log ID	Log Message	Comment	Action
5	Memory allocation failure. Unable to log last event.	Internal Component Failure. Log system may not be working properly.	If problem persists, contact Technical Support to investigate.
6	Socket call failed. Will not be able to communicate with specific component. Error no:%d.	Internal Component Failure. Log system may not be working properly.	If problem persists, contact Technical Support to investigate.
7	Socket select error - 100% CPU utilization can occur and overall system performance will be impaired.	Internal Component Failure. Log system may not be working properly.	If problem persists, contact Technical Support to investigate.
8	The evaluation license for the controller has expired. Please contact your customer representative and purchase licenses to continue using the controller. If you do not purchase a license, the legal requirement is to put the system out of service.	System operation is severely restricted by lack of valid license.	Contact Sales Support ASAP to request new License
Major			
9	The controller evaluation license will expire inns days. Please contact your customer representative and purchase licenses to continue using the controller.	System operation is severely restricted by lack of valid license. Contact Sales support to request new license	If problem persists, contact Technical Support to investigate.
10	Audit message error. Unable to log audit message.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.
11	Unknown internal program message received - type%d. Message will be ignored and processing continued.	Component out of sync with database. Log system may not be working properly.	If problem persists, contact Technical Support to investigate.
12	Low water mark level was reached!	Log message system log information. No action required.	None
13	High water mark level was reached. Dropping all log messages and AP alarms!	Too many outstanding logs. Log system may not be working properly.	If problem persists, contact Technical Support to investigate.
14	Failed to connect to the infrastructure bus.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.
15	Unable to determine trace file size - Error no:%d. Message will be dropped.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.
16	Unable to open audit file - Error no:%d. Message will be dropped.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.

Table 15: EVENT_SERVER (1) logs and events (Continued)

Log ID	Log Message	Comment	Action
17	Unable to determine audit file size - Error no:%d. Message will be dropped.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.
18	Cannot write to file - Error no:%d. Message will be dropped.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.
19	File pointer information corrupted - File sized. Message will be dropped.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.
20	Cannot reset file pointer to beginning of the log file - Error no:%d. The message and subsequent messages will be dropped.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.
21	Trying to read non-empty file - Error no:%d. Message will be dropped.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.
22	Cannot reset audit file pointer to beginning of the audit file - Error no:%d. The message and subsequent messages will be dropped.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.
23	Cannot set audit file pointer to specific position in the log - Error no:%d. The message and subsequent messages will be lost.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.
24	Cannot reset log file pointer to beginning of log file - Error no:%d. The message and subsequent messages will be dropped.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.
25	Cannot reset audit file pointer to specific position in the audit file - Error no:%d. The message and subsequent messages will be dropped.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.
26	Cannot reset trace file pointer to beginning of the trace file - Error no:%d. The message and subsequent messages will be dropped.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.
27	Cannot reset trace file pointer to specific position in the trace file - Error no:%d. The message and subsequent messages will be dropped.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.

Table 15: EVENT_SERVER (1) logs and events (Continued)

Log ID	Log Message	Comment	Action
28	Message has been written to the log but an error was encountered when closing the file - Error no:%d.	Internal Component Failure. Log system may not be working properly. Failed to log configuration change.	If problem persists, contact Technical Support to investigate.
29	Unable to open AP detection log file - Error no:%d. Message will be dropped.	Failure in Rogue AP Detection Logging. Reporting of rogue devices may be affected. Only relevant if Summit spy is enabled.	If problem persists, contact Technical Support to investigate.
30	Unable to determine AP detection log file size - Error no:%d. Message will be dropped.	Failure in Rogue AP Detection Logging. Reporting of rogue devices may be affected. Only relevant if Summit spy is enabled.	If problem persists, contact Technical Support to investigate.
31	Cannot reset AP detection log file pointer to beginning of file - Error no:%d. The message and subsequent messages will be dropped.	Failure in Rogue AP Detection Logging. Reporting of rogue devices may be affected. Only relevant if Summit spy is enabled.	If problem persists, contact Technical Support to investigate.
32	Cannot set AP detection log file pointer to specific position in the log - Error no:%d. The message and subsequent messages will be lost.	Failure in Rogue AP Detection Logging. Reporting of rogue devices may be affected. Only relevant if Summit spy is enabled.	If problem persists, contact Technical Support to investigate.
Minor			
39	Failed to delete old exported file [%s].	Old Log file has remained in the system and may affect ability to export further reports. Contact Technical Support to investigate	If problem persists, contact Technical Support to investigate.
40	Cannot export image. There already are [%d] images exported.	Too many reports open. Close some reports and retry.	If problem persists, contact Technical Support to investigate.
41	Failed to receive message.	n/a	n/a
42	Incoming message dropped, because of the rate limiting mechanism.	n/a	n/a
43	Unable to format msg from index [%d].	Problem interpreting log message. Log entry may not be performed. Low impact to the system.	If problem persists, contact Technical Support to investigate.
44	Unknown message type [%d].	Problem interpreting log message. Log entry may not be performed. Low impact to the system.	If problem persists, contact Technical Support to investigate.
45	Error reading property [%s].	Problem interpreting log message. Log entry may not be performed. Low impact to the system.	If problem persists, contact Technical Support to investigate.
46	Wrong bitmask size [%d].	Problem interpreting log message. Log entry may not be performed. Low impact to the system.	If problem persists, contact Technical Support to investigate.

Table 15: EVENT_SERVER (1) logs and events (Continued)

Log ID	Log Message	Comment	Action
47	Payload initialization failed for message type [%d].	Problem interpreting log message. Log entry may not be performed. Low impact to the system.	If problem persists, contact Technical Support to investigate.
48	Invalid information [%d]. Dropping the message.	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
49	Invalid length [%d] for AP serial number.	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
50	Failed to extract SNMP PDU.	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
51	Decoded SNMP PDU is NULL.	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
52	Failed to update entries from PDU. Error [%d].	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
53	Invalid severity ID [%d].	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
54	Invalid AP alarm severity [%d].	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
55	Failed to send formatted log message.	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
56	Invalid OIDs in the AP alarm PDU.	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
57	No entries found in the AP alarm PDU.	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
58	Unable to get value from [%s].	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
59	[%s] not set in the AP alarm.	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.

Table 15: EVENT_SERVER (1) logs and events (Continued)

Log ID	Log Message	Comment	Action
60	SNMP encode failed.	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
61	Message [%d] processing failed.	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
62	Invalid sort type [%d].	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
63	Unable to initialize array [%s].	Possible problem with logging system. If problem persists	If problem persists, contact Technical Support to investigate.
64	Invalid component index [%d].	Problem interpreting log message. Log entry may not be performed. Low impact to the system to the System.	If problem persists, contact Technical Support to investigate.
Info			
65	The log message database is being optimized. Log entries prior to this point in time will be temporarily unavailable.	Info.Temporary outage of log system. No action required.	None
66	No messages in the table.	Request for an empty log.	None
67	Bitmask was set to [%s].	Administrative change to log/ trace bitmask.	None
68	Sending messages to syslog feature is enabled.	n/a	None
69	Sending audit records to syslog feature is enabled.	n/a	None
70	Status request dropped. It was not sent for the Event Server.	No impact.	None
71	Unable to delete msg from view.	Possible problem with logging system.	If problem persists, contact Technical Support to investigate.
72	Unable to persist [%s] msg.	Possible problem with logging system.	If problem persists, contact Technical Support to investigate.
73	Failed to execute command [%s].	Possible problem with logging system.	If problem persists, contact Technical Support to investigate.
74	Unable to send log report response.	Possible problem with logging system.	If problem persists, contact Technical Support to investigate.
75	Unable to receive indexes for requested msgs.	Possible problem with logging system.	If problem persists, contact Technical Support to investigate.
76	No messages to export for the specified log type [%d].	Possible problem with logging system.	If problem persists, contact Technical Support to investigate.
77	Exported image already exists [%s].	Possible problem with logging system to the System.	If problem persists, contact Technical Support to investigate.
78	Exported image file [%s] cannot be opened.	Possible problem with logging system.	If problem persists, contact Technical Support to investigate.

Table 15: EVENT_SERVER (1) logs and events (Continued)

Log ID	Log Message	Comment	Action
79	Invalid AP SN [%s].	Possible problem with logging system.	If problem persists, contact Technical Support to investigate.
80	Invalid sort criteria [%s].	Possible problem with logging system.	If problem persists, contact Technical Support to investigate.
81	Unable to clear AP critical alarm. Alarm ID [%d].	Possible problem with logging system.	If problem persists, contact Technical Support to investigate.
82	Unable to send log export response.	Possible problem with logging system.	If problem persists, contact Technical Support to investigate.
83	Invalid page request [%d].	Possible problem with logging system.	If problem persists, contact Technical Support to investigate.

CONFIG_MANAGER (2)

Table 16: CONFIG_MANAGER (2) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	Config Manager has suffered a critical error and will halt. Error Details:%s	OAM configuration system restarts due to internal error. Active Configuration request may not have been processed. System will restart configuration manager.	If problem persists, contact Technical Support to investigate.
2	Access point controlled software upgrade has failed. This normally occurs if a corrupt image file was selected as the upgrade image. Please select another image for the upgrade:%s	Access Point upgrade fails. AP may be prevented to register with controller due to configuration mismatch.	If problem persists, contact Technical Support to investigate.
3	Access point automatic software upgrade/downgrade has failed. This normally occurs if a corrupt image file was selected as the default image. Please select another default image. This alarm will repeat as long as the system is in automatic mode:%s	Access Point upgrade fails. AP may be prevented to register with controller due to configuration mismatch.	If problem persists, contact Technical Support to investigate.
4	An AP has encountered an error processing configuration. Error details:%s	Access Point failed to process configuration set. AP is not able to provide service. Verify AP Image version to validate that controller and AP are properly matched.	If problem persists, contact Technical Support to investigate.

Table 16: CONFIG_MANAGER (2) logs and events (Continued)

Log ID	Log Message	Comment	Action
Major			
9	Config Manager has experienced an error which has prevented it from properly processing a request. CM will continue running, however this error may be an indicator of a larger system problem. Error Details:%s	Configuration/Administration request may not have been properly processed.	If problem persists, contact Technical Support to investigate.
10	Access point%s has reported a radar interference violation on%s. The affected radio(s) have been placed in auto channel select mode, and will not respond to channel changes until 30min after the radar interference is last detected.	Information. AP has responded to Radar signal information.	None
11	AP [%s] has not responded to a configuration change. The AP has been sent a reboot notification.	Access Point failed to acknowledge configuration set. AP may not be not be able to provide service. Verify AP Image version to validate that controller and AP are properly matched.	If problem persists, contact Technical Support to investigate.
Minor			
33	Config Manager has failed to process a request. Config Manager is still running, and system functionality is not impaired. Error Details:%s	Configuration/Administration request may not have been properly processed.	If problem persists, contact Technical Support to investigate.
Info			
65	Shutdown sequence initiated.	System is shutting down in response to administration operation (explicit request, software upgrade, license key, etc....)	None
66	Shutting down normally.	System is shutting down in response to administration operation (explicit request, software upgrade, license key, etc....)	None
70	New product key has been applied. Wireless Controller will be rebooted.	System is shutting down in response to administration operation (explicit request, software upgrade, license key, etc....)	None
	Config succeeded. Serial number:%s	Successful confirmation of AP configuration.	None
	Config failed. Serial number:%s	Access Point upgrade fails. AP may be prevented to register with controller due to configuration mismatch.	If problem persists, contact Technical Support to investigate.

Table 16: CONFIG_MANAGER (2) logs and events (Continued)

Log ID	Log Message	Comment	Action
	Unable to retrieve MAC address from AP	AP reports may be affected. Will not be able to determine BSSID for WM-AD assignment reports. Other feature impact such as RogueAP	If problem persists, contact Technical Support to investigate.
	Upgrading AP%s image from%s to%s	AP Image upgrade.	None
	Software version matches. Serial number:%s	Ap is running adequate firmware version. AP Registration will proceed	None
	Cannot send syslog enable notify.	Possible impact to Log System configuration in terms of logging to external log system. Retry applying syslog configuration.	If problem persists, contact Technical Support to investigate.
	Software config response sent out. Serial number:%s	Configuration of AP	None
	Upgrading Sensor (%s) image to ftp:%s to path:%s	AP role change	None
	Initial channel report has been successfully sent to AP. Serial number:%s	AP Channel report Feature	None
	Subsequent channel report has been successfully sent to AP. Serial number:%s	AP Channel report Feature	None

STATS_SERVER (3)

Table 17: STATS_SERVER (3) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	Statistics Server suffered an internal connection failure. Retrying connection in 5 seconds.	Internal Component Problem. Stats Server unable to establish proper inter-process communications. May affect system status reports, user accounting and CDRs.	If problem persists, contact Technical Support to investigate.
Minor			
33	Unable to create thread to register callbacks to Startup Manager. Stats Server will continue, but will be unable to respond to Startup Manager requests.	Internal Component Problem. Major component functions not affected.	If problem persists, contact Technical Support to investigate.

Table 17: STATS_SERVER (3) logs and events (Continued)

Log ID	Log Message	Comment	Action
35	Unable to start timer thread necessary to collect router port SNMP statistics	Affects ability to report statistic utilization of system interfaces. No deterrent effect to system operation other than to interface reports.	If problem persists, contact Technical Support to investigate.
36	Received empty AP bundle statistics record: There may be no active APs connected to the system.	n/a	None
37	Unable to determine local physical ports on system; port statistics will not be collected.	Affects ability to report statistic utilization of system interfaces. No deterrent effect to system operation other than to interface reports.	If problem persists, contact Technical Support to investigate.
Info			
65	Shutdown sequence initiated.	Administrator has requested system shutdown	None
66	Shutting down normally.	Administrator has requested system shutdown	None
67	Received shutdown request from SMT	n/a	None
68	Successfully connected to internal data sources.	n/a	None
69	Null input parameters received; ignoring message.	Minor internal communications issue.	If problem persists, contact Technical Support to investigate.
70	Request for router port SNMP statistics failed. No statistics reported for interval.	Affects ability to report statistic utilization of system interfaces. No deterrent effect to system operation other than to interface reports.	If problem persists, contact Technical Support to investigate.
72	Request for vnMgr statistics failed. No statistics will be reported for interval.	No deterrent effect to system functional operation. Affects ability to report Mobility domain statistics.	If problem persists, contact Technical Support to investigate.

SECURITY_MANAGER (4)

Table 18: SECURITY_MANAGER (4) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	Cannot allocate memory. Will not be able to process Captive portal authentication request.	Internal operation failure. Affects ability to provide authentication Token for Captive Portal session. User may retry again. Memory allocation indication may indicate problem with system resource utilization.	If problem persists, contact Technical Support to investigate.

Table 18: SECURITY_MANAGER (4) logs and events (Continued)

Log ID	Log Message	Comment	Action
2	Failed to initialize list of session tracking tags (token). Will not be able to process Captive portal authentication requests.	Internal operation failure. Affects ability to provide authentication Token for Captive Portal session. User may retry again to succeed.	If problem persists, contact Technical Support to investigate.
3	Unable to open listening socket. Will not be able to communicate with Apache server.	Unable to establish connection to authentication server. Affects ability to provide internal captive portal. Could indicate problem with Apache Server instantiation. Component could be restarted to see if problem persists.	If problem persists, contact Technical Support to investigate.
4	Error binding to listener socket. Will not be able to communicate with Apache server.	Unable to establish connection to authentication server. Affects ability to provide internal captive portal. Could indicate problem with Apache Server instantiation. Component could be restarted to see if problem persists	If problem persists, contact Technical Support to investigate.
5	Listen call failed. Will not be able to communicate with Apache Server.	Unable to establish connection to authentication server. Affects ability to provide internal captive portal. Could indicate problem with Apache Server instantiation. Component could be restarted to see if problem persists.	If problem persists, contact Technical Support to investigate.
6	Socket call failed. Will not be able to communicate with specific component.	Internal operation failure. May affect ability to provide user authentication.	If problem persists, contact Technical Support to investigate.
Major			
9	Status thread failed to start. Will not be able to communicate with startup/shutdown Mgr until status thread starts.		If problem persists, contact Technical Support to investigate.
13	Error occurred when sending response message to Apache server.		If problem persists, contact Technical Support to investigate.
16	Unable to create new session tracking tag (token mapping) based on MAC address. Will not be able to process Captive portal authentication request.		If problem persists, contact Technical Support to investigate.
17	Get next available session tracking tag (token) returns zero. Will not be able to process Captive portal authentication request.		If problem persists, contact Technical Support to investigate.

Table 18: SECURITY_MANAGER (4) logs and events (Continued)

Log ID	Log Message	Comment	Action
18	Error on deleting session tracking tag (token)%d. This will not impact success/failure of authentication request - it may create a memory leak if multiple tokens cannot be deleted.		If problem persists, contact Technical Support to investigate.
21	Client with MAC%s cannot be authorized on%s with filterName%s. The filterName is invalid on this%s		Validate Configuration of RadiusServer. Validate that matches WM-AD configuration. If problem persists contact Technical Support for assistance.
	Client with MAC%s cannot be authorized with filterName%s as this filterName is invalid on the%s with id%d		Validate Configuration of RadiusServer. Validate that matches WM-AD configuration. If problem persists contact Technical Support for assistance.
	Client with MAC%s cannot be authorized due to filter problems. Unable to resolve problem: failing MAC-based authorization request from client		Mapping issue for per-user radius assigned policy. User will be assigned default.
Minor			
33	Error trying to delete all session tracking tags (token mappings). As this only happens at shutdown, the memory will be released anyway.	No system impact but may indicate internal logic error in resource cleanup.	If problem persists, contact Technical Support to investigate.
34	Connect socket call failed. Will not be able to communicate with specific component.	Internal operation failure. May result in exhausting system memory resources.	If problem persists, contact Technical Support to investigate.
35	Client connected to BSSID:%s.	n/a	None
36	Client with MAC%s has failed authorization on AP <%s>.	Client on specific AP has failed authentication with controller.	Verify that user in question is properly configured to access network.
37	Client session MAC%s has failed authentication	Client on specific AP has failed authentication with controller	Verify that user in question is properly configured to access network.
Info			
65	Socket write failed. The TCP connection is down. The authentication request will fail for the session, however the secMgr will try to re-connect to the "downed" component.	Possible outage in user authentication subsystem. User will most likely re-attempt to clear situation.	If problem persists, contact Technical Support to investigate.
66	Socket read failed with errno%d. The TCP connection is down. The authentication request will fail for the session, however the secMgr will try to re-connect to the "downed" component.	Possible outage in user authentication subsystem. User will most likely re-attempt to clear situation.	If problem persists, contact Technical Support to investigate.

Table 18: SECURITY_MANAGER (4) logs and events (Continued)

Log ID	Log Message	Comment	Action
67	Error trying to close all sockets. However, they will time out on their own.	No negative impact to system. However indicates possible issue with resource de-allocation.	If problem persists, contact Technical Support to investigate.
68	Cannot connect to Radius Client. Will keep trying until connection is successful.	Inter-communications issue. Component re-attempts should restore proper link. However, if un-resolved will not allow authentication to proceed and therefore blocking any users from gaining proper access to network.	If problem persists, contact Technical Support to investigate.
69	Cannot connect to EAP. Will keep trying until connection is successful.	Inter-communications issue. Component re-attempts should restore proper link. However, if un-resolved will not allow EAP (WPA) authentication to proceed and therefore blocking any users in AAA assigned WM-ADs.	If problem persists, contact Technical Support to investigate.
70	Internal communication failure - cannot make internal data connection. Will keep trying until connection is successful.	Internal interprocess communication issue.	If problem persists, contact Technical Support to investigate.
71	Error on socket select. The socket must have already been closed.This should not impact whether an authentication request succeeds or fails for a session.	Internal interprocess communication issue.	If problem persists, contact Technical Support to investigate.
72	Error accepting new socket. Will not be able to receive login information from Apache server.	Internal interprocess communication issue. Users authenticated via internal captive portal may not reach authenticated state even with proper credentials. Component may need to be restarted.	If problem persists, contact Technical Support to investigate.
73	Error trying to send a message to Radius Client. Captive portal authentication request will fail.	Internal interprocess communication issue. Users authenticated via internal captive portal may not reach authenticated state even with proper credentials. Component may need to be restarted.	If problem persists, contact Technical Support to investigate.
74	Send SECMGR_MU_AUTHENTICATED _NOTIFY message failed for token%d	Internal interprocess communication issue. Users authenticated via internal captive portal may not reach authenticated state even with proper credentials. Component may need to be restarted.	If problem persists, contact Technical Support to investigate.

Table 18: SECURITY_MANAGER (4) logs and events (Continued)

Log ID	Log Message	Comment	Action
75	Received failure from Config Manager for default filter - configuration is incorrect or incomplete!	Internal configuration issue encountered. User filter policy will be applied as "Default" rather than more specific filterID indicated through radius authentication. User network access to network may be different than administration intended.	If problem persists, contact Technical Support to investigate.
78	Cannot find session tracking tag (token)%d. The Captive portal or MAC-based authentication request may already have been processed.	Authentication token for Captive portal received for user that is no longer listed as pending authentication. User will be redirected to internal captive portal if authentication hasn't indeed changed.	If problem persists, contact Technical Support to investigate.
79	Could not find the session information (token information) for session tracking tag (token)%d. Will not be able to process Captive portal authentication request.	Authentication token for Captive portal received for user that is no longer listed as pending authentication. User will be redirected to internal captive portal if authentication hasn't indeed changed resetting condition.	If problem persists, contact Technical Support to investigate.
80	Could not find session tracking tag (token) by MAC address. Will not be able to process Captive portal authentication request.	Authentication token for Captive portal received for user that is no longer listed as pending authentication. User will be redirected to internal captive portal if authentication hasn't indeed changed resetting condition.	If problem persists, contact Technical Support to investigate.
81	Received invalid session tracking tag (token) from Apache server. Token cannot be zero. Will not be able to process Captive portal authentication request.	Authentication token for Captive portal received for user that is no longer listed as pending authentication. User will be redirected to internal captive portal if authentication hasn't indeed changed resetting condition.	If problem persists, contact Technical Support to investigate.
82	Invalid message Id%d received from Radius Client. Authentication request for the session will fail.	Authentication response is not processed. User will re-attempt and situation shall clear itself.	If problem persists, contact Technical Support to investigate.
83	The user (with session tracking tag%d) cannot authenticate as the message to the Radius Server has timed out. Please check if configuration (especially Radius Server IP Address) is correct.	Possible problem with configuration or availability of Radius Server.	If problem persists, contact Technical Support to investigate.
84	A message has been sent to the Apache Server indicating that the authentication message for session%d to the Radius Server has timed out.	Notification to user.	None

Table 18: SECURITY_MANAGER (4) logs and events (Continued)

Log ID	Log Message	Comment	Action
85	The user with session tracking tag%d cannot authenticate due to an internal error in the component (Radius Client) which communicates with the Radius Server.	Possible problem with configuration or availability of Radius Server.	Validate Configuration of RadiusServer. Verify Reacheability of RadiusServer utilizing the RadiusTest feature in GlobalSettings. If problem persists contact Technical Support to investigate.
86	The user with session tracking tag%d cannot authenticate due to a conflict in the shared secret key for the Radius Server. Please check your configuration.	Possible problem with configuration or availability of Radius Server.	Validate Configuration of RadiusServer. Verify Reacheability of RadiusServer utilizing the RadiusTest feature in GlobalSettings. If problem persists contact Technical Support to investigate.
87	Client session MAC%s has been successfully authenticated.	n/a	None
88	Client with MAC%s has been successfully authorized on AP <%s>.	n/a	None

RU_MANAGER (6)

Table 19: RU_MANAGER (6) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	RU Manager has suffered a critical internal error and will halt (unable to start process thread).	Internal operation problem. May affect ability of Aps to register with controller. Component should be restarted.	If problem persists, contact Technical Support to investigate.
2	RU Manager has suffered a critical internal error and will halt (unable to open data dictionary).	Internal operation problem. May affect ability of Aps to register with controller. Component should be restarted.	If problem persists, contact Technical Support to investigate.
3	AC Manager: Moving into failover mode	Controller entering into Failover Mode. Indicates that link with peer controller has been lost. Peer controller may have shutdown or may indicate problem with interconnecting network. If Peer controller has indeed failed and network connections are intact APs will now begin failing to surviving controller.	Investigate state of peer controller. Review log entries on it to determine appropriate action.

Table 19: RU_MANAGER (6) logs and events (Continued)

Log ID	Log Message	Comment	Action
Major			
9	An AP has attempted to connect that is unknown to the system. AP authentication failure.%s.	AP With incorrect credentials attempted to register. AP shall engage in re-discovery and re-establish proper credentials.	If problem persists contact Technical Support to investigate.
10	AP fails discovery.%s	AP has failed the discovery registration process.	If problem persists contact Technical Support to investigate.
11	Access Point failed registration: Maximum license limit of APs reached.%s	More Aps than allowed by MVL attempted to register with controller. Some AP may become unable to provide RF service	Verify number of Aps allowed by MDL portion of License. Contact Sales Support to discuss capacity allowance increase criteria.
12	Remote Access Point failed registration: Maximum license limit of APs reached.%s	MDL Mismatch. More AP attempted to failover from availability peer. Recommend systems support same capacity. Some AP may become unable to provide RF service.	Verify number of Aps allowed by MDL portion of License. Verify that purchase limits match on both systems. Contact Sales support to discuss allowance increases.
13	Lost connectivity with Availability Peer%s.	Controller entering into Failover Mode. Indicates that link with peer controller has been lost. Peer controller may have shutdown or may indicate problem with interconnecting network. If Peer controller has indeed failed and network connections are intact APs will now begin failing to surviving controller.	Investigate state of peer controller. Review log entries on it to determine appropriate action.
Minor			
33	Internal error occurred for a single request. RU Manager will ignore the error and continue.	Failure to process AP registration request. AP will likely retry.	If problem persists contact Technical Support to investigate.
34	Challenge-response key cache is full. Until some of the existing access point's are authenticated, new registration requests will be ignored.	Temporary congestion of AP registration requests. Problem should resolve itself.	If problem persists contact Technical Support to investigate.
35	Internal error occurred for a single request. RU Manager will ignore the error and continue.	Failure to process AP registration request. AP will likely retry.	If problem persists contact Technical Support to investigate.
37	SLP registration failed. RU Manager will retry registration in 10 seconds.	Failure to register AP SLP discovery identifiers. Aps may not be able to find controller. Problem should fix itself and Aps will continue to retry.	If problem persists contact Technical Support to investigate.
38	AC Manager: Unauthorized client%s attempting to connect.	Unregistered Peer attempting to establish an availability pair. Possible misconfiguration in Availability pairings.	Verify Availability pairing configuration in both controllers. If indeed configuration is correct, contact Technical Support to investigate.

Table 19: RU_MANAGER (6) logs and events (Continued)

Log ID	Log Message	Comment	Action
39	AC manager: Unable to set foreign ports in database.	Possible failure to update availability pair configuration. May affect Aps ability to failover properly and expediently.	If problem persists contact Technical Support to investigate.
40	AC manager: Unable to set foreign APs in database.	Possible failure to register Failed over Aps. May affect MDL licensing and AP registration.	If problem persists contact Technical Support to investigate.
41	AC Manager: Unable to update foreign APs in database.	"Availability"	If problem persists contact Technical Support to investigate.
42	Access point%s attempting to connect but maximum licensed connections reached.	Licensed MDL reached. Additional Aps may not become Active therefore affecting intended coverage area.	Validate License Key parameters. Contact Sales Support to discuss options on capacity increase.
Info			
65	AP registered.%s	AP Identified by Serial Number has registered.	None
66	AP authenticated.%s	AP Identified by Serial Number has registered.	None
67	RU Manager started normally.	Component state.	None
68	RU Manager shutting down normally.	Component state.	None
69	SLP registration successful.	Component state.	None
71	AC Manager: Recovering from failover to normal mode	Availability pairing restored.	None
72	AP connects for registration.%s	AP registration.	None
73	AP connects for discovery.%s	AP registration.	None
74	AC Manager Configuration:%s	Info. Availability Pairing configuration.	None
75	Could not add foreign AP to database. Perhaps it already exists as a local AP. Serial number is%s.	Possible conflict with AP configuration record.	If problem persists contact Technical Support to investigate.
76	Licensed maximum AP registrations exceeded, authentication fails:%s.	Licensed MDL reached. Additional Aps may not become Active therefore affecting intended coverage area.	Validate License Key parameters. Contact Sales Support to discuss options on capacity increase.
77	Unable to add foreign AP, license limit exceeded.	Licensed MDL reached. Additional Aps may not become Active therefore affecting intended coverage area. Ensure failover capacity matches between the two controllers.	Licensed MDL reached. Additional Aps may not become Active therefore affecting intended coverage area.
78	Availability Link established with Peer%s.	Info. Availability pairing restored.	None

RADIUS_CLIENT (7)

Table 20: RADIUS_CLIENT (7) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	A file system error occurred. Unable to open RADIUS dictionary file. RADIUS client exiting.	Possible initialization problem for RadiusClient component. May affect ability of users to authenticate with system and therefore affect their ability to gain network access.	If problem persists contact Technical Support to investigate.
2	Cannot allocate memory for either Captive Portal and/or EAP modules. RADIUS client exiting.	Possible resource utilization with system. May affect ability of users to authenticate with system and therefore affect their ability to gain network access. Component may need to be restarted to resolve issue, or may indicate larger problem with system's resource utilization.	If problem persists contact Technical Support to investigate.
3	Failed to send process status success to Startup Manager. Start-up Manager will reboot the RADIUS client.	Component may be restarted by system health monitoring facility. May cause temporary outage to authentication sub-system. Issue should self resolve after reset.	If problem persists contact Technical Support to investigate.
4	No radius server available for subnet:%s.	Possible problem with configuration or availability of Radius Server. Users may be unable to gain proper network access.	Validate Configuration of RadiusServer. Verify Reacheability of RadiusServer utilizing the RadiusTest feature in GlobalSettings. If problem persists contact Technical Support to investigate.
Major			
9	Failed to retrieve configuration from the Config Manager. Will retry connection to Config Manager.	Possible problem with configuration of authentication sub-system, in particular may become unable to determine correct Radius Configuration. Connection retry should resolve condition.	If problem persists contact Technical Support to investigate.
10	Radius server changed:%s	Configuration of RadiusServer changed by administration.	None
11	Failed to get radius profile for subnet:%s.	Possible problem with configuration or availability of Radius Server. Users may be unable to gain proper network access.	Validate Configuration of RadiusServer in GlobalSettings and in WM-AD definition. Verify Reacheability of RadiusServer utilizing the RadiusTest feature in GlobalSettings. If problem persists contact Technical Support to investigate.

Table 20: RADIUS_CLIENT (7) logs and events (Continued)

Log ID	Log Message	Comment	Action
Minor			
33	Config Manager returned wrong flag. Will retry retrieving configuration.	Possible problem with configuration of authentication sub-system, in particular may become unable to determine correct Radius Configuration. Connection retry should resolve condition.	If problem persists contact Technical Support to investigate.
34	Internal error occurred for a single request. RADIUS client will ignore the error and continue.	Possible issue with configuration of authentication sub-system. User should re-attempt the registration thus resolving issue.	If problem persists contact Technical Support to investigate.
35	Invalid radius server IP. Subnet%d is not available.	Possible problem with configuration or availability of Radius Server. Users may be unable to gain proper network access.	Validate Configuration of RadiusServer in GlobalSettings and in WM-AD definition. Verify Reacheability of RadiusServer utilizing the RadiusTest feature in GlobalSettings. If problem persists contact Technical Support to investigate.
36	Invalid NAS IP. Subnet%d is not available.	Possible problem with configuration or availability of Radius Server. Users may be unable to gain proper network access.	Validate Configuration of RadiusServer in GlobalSettings and in WM-AD definition. Verify Reacheability of RadiusServer utilizing the RadiusTest feature in GlobalSettings. If problem persists contact Technical Support to investigate.
37	Invalid retry count for subnet%d. Default value will be used.	Possible problem with configuration or availability of Radius Server or WM-AD configuration of radius parameters. Default parameters will be used. No expected impact to user authentication.	Validate Configuration of RadiusServer in GlobalSettings and in WM-AD definition. Verify Reacheability of RadiusServer utilizing the RadiusTest feature in GlobalSettings. If problem persists contact Technical Support to investigate.
38	Invalid timeout setting for subnet%d. Default value will be used.	Possible problem with configuration or availability of Radius Server or WM-AD configuration of radius parameters. Default parameters will be used. No expected impact to user authentication.	Validate Configuration of RadiusServer in GlobalSettings and in WM-AD definition. Verify Reacheability of RadiusServer utilizing the RadiusTest feature in GlobalSettings. If problem persists contact Technical Support to investigate.
39	Invalid radius server port number for subnet%d. Default value will be used.	Possible problem with configuration or availability of Radius Server or WM-AD configuration of radius parameters. Default parameters will be used. If default value doesn't provide reachability of RadiusServer, users may be unable to authenticate.	Validate Configuration of RadiusServer in GlobalSettings and in WM-AD definition. Verify Reacheability of RadiusServer utilizing the RadiusTest feature in GlobalSettings. If problem persists contact Technical Support to investigate.

Table 20: RADIUS_CLIENT (7) logs and events (Continued)

Log ID	Log Message	Comment	Action
40	Invalid NAS port number for subnet%d. Default value will be used.	Possible problem with configuration or availability of Radius Server or WM-AD configuration of radius parameters. Default parameters will be used. No expected impact to user authentication.	Validate Configuration of RadiusServer in GlobalSettings and in WM-AD definition. Verify Reacheability of RadiusServer utilizing the RadiusTest feature in GlobalSettings. If problem persists contact Technical Support to investigate.
41	Mismatched IP addresses:%s	Possible problem with configuration or availability of Radius Server or WM-AD configuration of radius parameters. Default parameters will be used. No expected impact to user authentication.	Validate Configuration of RadiusServer in GlobalSettings and in WM-AD definition. Verify Reacheability of RadiusServer utilizing the RadiusTest feature in GlobalSettings. If problem persists contact Technical Support to investigate.
42	WPA2 pre-authentication failure.%s.	User failed authentication.	Validate user credentials configuration. If problem persist with proper user configuration contact Technical Support to investigate
Info			
65	RADIUS server authenticated login (Access Accepted).	User authentication successful	None
66	RADIUS server rejected login (Access Rejected).	User failed authentication	Validate user credentials configuration. If problem persist with proper user configuration contact Technical Support to investigate.
67	Radius Request: %s	Radius Authentication State	None
68	Radius Response: %s	Radius Authentication State	None
69	WPA2 pre-authentication success. %s.	Radius Authentication State	None

HOST_SERVICE_MANAGER (8)

Table 21: HOST_SERVICE_MANAGER (8) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	Failed to set management IP address ' + newData[1] + '. Please check your network for probable conflict. Rolling back to IP address ' + currentData[1] + '.'	Possible network conflict for system IP address. Configuration request failed.	Verify network topology and addressing.

WADMGR (9)

Table 22: WADMGR (9) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	Critical internal error - memory protection flags have been corrupted. Mobility Manager will halt.	Internal operation problem. May affect Mobility Domain state. Component will be restarted automatically.	If problem persists contact Technical Support to investigate.
2	Internal system interrupt handlers failed to initialize. Mobility Manager will halt.	Internal operation problem. May affect Mobility Domain state. Component will be restarted automatically.	If problem persists contact Technical Support to investigate.
3	Unable to initialize internal program thread. Mobility Manager will halt.	Internal operation problem. May affect Mobility Domain state. Component will be restarted automatically.	If problem persists contact Technical Support to investigate.
4	Critical internal error - unable to allocate memory for Mobility Manager. Mobility Manager will halt.	Internal operation problem. May affect Mobility Domain state. Component will be restarted automatically. However, failure condition may indicate larger issue with memory resource utilization in the system.	If problem persists contact Technical Support to investigate.
5	Socket call failed. Will not be able to communicate with specific component.	Internal operation issue. May affect Mobility domain state. Component will be restarted automatically.	If problem persists contact Technical Support to investigate.
6	Unable to initialize internal program data structure. Mobility Manager will halt.	Internal operation issue. May affect Mobility domain state. Component will be restarted automatically.	If problem persists contact Technical Support to investigate.

Table 22: WADMGR (9) logs and events (Continued)

Log ID	Log Message	Comment	Action
7	Unable to determine configuration: exiting serverthread.	Possible problem with configuration of Mobility feature component subset. Inter-Controller Mobility functionality may not be functional	If problem persists contact Technical Support to investigate.
	Unable to update configuration: exiting serverthread	Possible problem with configuration of Mobility feature component subset. Possibly Minor impact on Inter-Controller feature	If problem persists contact Technical Support to investigate.
	Unable to update main AC List with own information: exiting serverthread	Internal operation issue. May affect Mobility domain state. Component may need to be reset.	If problem persists contact Technical Support to investigate.
	Unable to update tunnel list with own information: exiting serverthread	Internal operation issue. May affect Mobility domain feature state. Component may need to be reset.	If problem persists contact Technical Support to investigate.
	Malloc failed	Internal operation problem. May affect Mobility Domain state. Component will be restarted automatically. However, failure condition may indicate larger issue with memory resource utilization in the system.	If problem persists contact Technical Support to investigate.
Major			
9	Configuration error - missing or bad parameters. Mobility Manager will retry configuration request. Mobility Manager will not start-up until configuration is successful.	Possible problem with configuration of Mobility feature component subset. Inter-Controller Mobility functionality may not be functional	Verify Mobility Feature configuration. Contact Technical Support for investigation
10	Set Configuration data failed. The Mobility Manager may be restarted.	Possible problem with configuration of Mobility feature component subset. Possibly Minor impact on Inter-Controller feature.	If problem persists contact Technical Support to investigate.
11	Get Configuration data failed. The Mobility Manager may be restarted.	Possible problem with configuration of Mobility feature component subset. Possibly Minor impact on Inter-Controller feature.	If problem persists contact Technical Support to investigate.
12	Internal status changed. Mobility Manager will shutdown and be re-started by the Start-up Manager.	Role change by Administrator.	None

Table 22: WADMGR (9) logs and events (Continued)

Log ID	Log Message	Comment	Action
13	Mobility Manager has received incomplete filterId information for the client with MAC%s. This client will be treated as experiencing an authorization error.	MAC based authentication. User will be disconnected and forced to re-authenticate with system	If problem persists contact Technical Support to investigate.
	Mobility Manager has received invalid authentication information for the client with MAC%s. This client will be treated as experiencing an authorization error.	MAC based authentication. User will be disconnected and forced to re-authenticate with system	If problem persists contact Technical Support to investigate.
14	Received unknown message type%d from Langley (CM socket).	Internal processing issue. Unrecognized command. Should have no impact on system or inter-controller mobility operation.	If problem persists contact Technical Support to investigate.
15	Heart-beat interval has expired - have missed too many heart-beats from Mobility Manager. Mobility Agent will reset all remote client information and revert to nodal operation.	Agent-Controller link has expired. Controller reverts to nodal state. Users roaming in/ out of controller will need to re-establish new sessions, require re-authentication and topology update.	Validate state of peer controllers. Analyze logs on controllers to determine appropriate action.
16	Update interval has expired for Mobility Agent with IP address%s. Mobility Manager will remove all information for Mobility Agent including client session information.	Agent-Controller link has expired. Controller reverts to nodal state. Users roaming in/ out of controller will need to re-establish new sessions, require re-authentication and topology update.	Validate state of peer controllers. Analyze logs on controllers to determine appropriate action.
17	Mobility Control connection attempted by unrecognized peer%s. Peer will not be allowed to connect.	Mobility membership in protected mode.	Administrator must approve new system to grant access to Mobility domain.
18	Connection identifiers for Mobility establishment exhausted. Please remove stale identifiers from permissions list.	Maximum number of peers in mobility domain (127) reached. New controllers will not be allowed to join mobility domain.	Administrator should clean up stale registered mobility domain elements.
19	Agent has been informed that all connection identifiers for Mobility establishment exhausted. Please remove stale identifiers from permissions list on manager.	Maximum number of peers in mobility domain (127) reached. New controllers will not be allowed to join mobility domain.	Administrator should clean up stale registered mobility domain elements.
20	Establishment of control tunnel with Mobility Manager failed. Please verify Mobility configuration for both Agent and target Manager.	Possible problem with configuration of Mobility feature component subset. Inter-Controller Mobility functionality may not be functional.	Verify Mobility Feature configuration. If problem persists Contact Technical Support for investigation.
Minor			
33	Client%s.	Mobility Peer Identification	None
34	Client%s.	Mobility Peer Identification	None

Table 22: WADMGR (9) logs and events (Continued)

Log ID	Log Message	Comment	Action
35	Mobility Manager failed to received response for MAC-based authorization for client with MAC%s.	MAC based authentication. User will be disconnected and forced to re-authenticate with system.	If problem persists Contact Technical Support for investigation.
36	Connection established with:%s	Mobility Peer Identification	None
Info			
65	Mobility Manager shutting down normally.	Administrator requested system termination. System will shutdown. Mobility Domain will be terminated.	None
66	Mobility Manager sending a disconnect message to all neighbors.	Mobility Manager has determined that Mobility Domain should be terminated. Typical for role changing and shutdown conditions.	None
67	Mobility Manager was unable to de-register the SLP service registration. SLP Directory Agent may report an out-of-date service registration.	Possible issue with inter-AC discovery.	If problem persists Contact Technical Support for investigation.
68	Sending a disconnect message to the Mobility Manager.	Client determines need to disconnect from mobility domain.	None
69	Mobility Manager has been unable to register itself as a service with slpd.	Possible issue for inter-AC discovery. Component will retry.	If problem persists Contact Technical Support for investigation.
70	Timeout occurred for configuration message. Error will be ignored and another configuration message resent.	Mobility subsystem initialization problem. Component will retry.	If problem persists Contact Technical Support for investigation.
71	Configuration change successful.	Record change to configuration parameters	None
72	Sending disconnect to neighbor with IP address%s.	Mobility State management	None
73	Sending configuration change to neighbor with IP address%s.	Mobility State management	None
74	Mobility Agent disconnected from the Mobility Manager. Agent will attempt to reconnect with the Mobility Manager.	Mobility State management	None
76	Mobility Agent has found a Mobility Manager at IP address%s.	Mobility State management	None
77	Communication heart-beat interval changed to%d.	Mobility Configuration management. Administrator change.	None
78	Default communication heart-beat time changed.	Mobility Configuration management. Administrator change.	None

Table 22: WADMGR (9) logs and events (Continued)

Log ID	Log Message	Comment	Action
79	Slpd service or attribute change successful.	Mobility Configuration management. Administrator change.	None
80	Configuration change successful.	Mobility Configuration management. Administrator change.	None
81	Two or more ACs are proclaiming that they are the home for an MU with the MAC address%s. The Mobility Manager will be informed and will resolve this conflict.	Conflict Resolution. User will be disconnected from Mobility domain to force proper re-authentication at point-of-presence.	None
82	MU information may have changed or MU may have roamed.%s.	Mobility State management	None
83	Successful MAC authorization for client%s.	MAC Auth State	None
84	The Access Controller ID in the client registration message is empty. Other AC's will not be notified about this client.	n/a	n/a
85	Connection with Mobility Manager not successful with Version 2. Reattempting with Version 1.	Backwards compatibility. V4.0 Controller attempting to register with V3.1.	None

STACK_ADAPTER (10)

Table 23: STACK_ADAPTER (10) logs and events

Log ID	Log Message	Comment	Action
Info			
65	Fast Ethernet Stack Adaptor Started.	System initialization state	None
66	Gigabit Ethernet Stack Adapter Started.	System initialization state	None

CLI (11)

Table 24: CLI (11) logs and events

Log ID	Log Message	Comment	Action
Major			
9	Upgrade process failed - failure reason:%s.	System application/firmware upgrade process failed. System operating components and personality may be lost as a result.	If problem persists Contact Technical Support for investigation.
10	System restore process failed - failure reason:%s.	Database restore procedure failed. System configuration may not be up to level customer intends.	If problem persists Contact Technical Support for investigation.
11	Patch installation failed - failure reason:%s.	System update failed. System software base may not be fully installed and may result in subsequent failures of operations.	If problem persists Contact Technical Support for investigation.
12	Process%s killed by restart CLI command.	n/a	n/a
Minor			
33	FTP for%s failed. Back-up process failed	FTP operation failed. Revisit operation parameters.	If problem persists Contact Technical Support for investigation.
34	failure reason:%s.	Database backup procedure failed. Revisit operation parameters and storage availability.	If problem persists Contact Technical Support for investigation.
Info			
65	FTP for%s started.	FTP operation state	None
66	FTP for%s successful.	FTP operation state	None
67	Back-up process started.	Backup Procedure state	None
68	Back-up process successful.	Backup Procedure state	None
69	Upgrade process started.	Backup Procedure state	None
70	Upgrade process successful.	Upgrade Procedure state	None
71	System restore process started.	Restore Procedure state	None
72	System restore process successful.	Restore Procedure state	None
73	Upgrade in progress. System reboot started.	System shutdown due to upgrade process requested by Admin.	None
74	System reboot requested.	System Shutdown requested by Admin	None
75	System halt requested.	System Shutdown requested by Admin	None
76	Patch installation started.	System Software Maintenance State	None

Table 24: CLI (11) logs and events (Continued)

Log ID	Log Message	Comment	Action
77	Patch installation successful.	System Software Maintenance State	None

LANGLEY (13)

Table 25: LANGLEY (13) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	Langley has suffered a critical error, and has halted. Error Details:%s	Internal communications issue. Possible interruption in inter-process communication.	If problem persists Contact Technical Support for investigation.
Major			
9	Langley has experienced an error which has prevented it from properly processing a request. Langley will continue running, however this error may be an indicator of a larger system problem. Error Details:%s	Internal communications issue. Possible interruption in inter-process communication.	If problem persists Contact Technical Support for investigation.
10	A connection request from '%s' failed to authenticate with the messaging server. This may indicate that somebody is port-scanning the access controller, or is attempting to gain backdoor access.	Possible Denial of Service attack.	Verify credentials of source. If problem persists and problem is deemed to be associated with internal component, contact Technical Support to investigate.
Minor			
33	Langley has failed to process a request. Langley is still running, and system functionality is not impaired. Error Details:%s	Internal communications issue.Minor interruption in inter-process communication.	If problem persists Contact Technical Support for investigation.
Info			
65	Shutdown sequence initiated.	Administrator requested system shutdown.	None
66	Shutting down.	Administrator requested system shutdown.	None
67	Timeout receiving message from component%d on fd%d. Connection closed.	Internal communications issue. Possible interruption in inter-process communication.	If problem persists Contact Technical Support for investigation.

NSM_SERVER (15)

Table 26: NSM_SERVER (15) logs and events

Log ID	Log Message	Comment	Action
Major			
9	NSM suffered an internal connection failure. Re-trying connection.	Internal operation issue. Retrial should resolve issue.	If problem persists Contact Technical Support for investigation.
10	NSM suffered an internal messaging failure. Re-trying connection.	Internal operation issue: Retrial should resolve issue.	If problem persists Contact Technical Support for investigation.
11	Can not set MTU for interface%s.	Possible configuration problem. May affect system ability to communicate properly with its network peers.	If problem persists Contact Technical Support for investigation.
Minor			
33	Unknown internal program message received - type%d. Message will be ignored and processing continued.	Internal communications issue. No direct impact to system operation, however may be symptom of more serious condition.	If problem persists Contact Technical Support for investigation.
Info			
65	NSM started normally.	Component state	None
67	Static route deleted successfully.	Route configuration state	None
68	Get static routes successful.	Route configuration state	None

OSPF_SERVER (17)

Table 27: OSPF_SERVER (17) logs and events

Log ID	Log Message	Comment	Action
Major			
9	OSPF server suffered an internal messaging failure. Re-trying connection.	OSPF restart purges routing table resulting in temporary outage of routing topology. Aps may disconnect from controller affecting wireless domain. Retrial shall restore routing state.	If problem persists Contact Technical Support for investigation.
Minor			
33	Unknown internal program message received - type%d. Message will be ignored and processing continued.	Internal communications issue. No direct impact to system operation, however may be symptom of more serious condition.	If problem persists Contact Technical Support for investigation.

Table 27: OSPF_SERVER (17) logs and events (Continued)

Log ID	Log Message	Comment	Action
Info			
65	NSM started normally.	Component state	None
66	Static route deleted successfully.	Component state	None
67	Get static routes successful.	Component state	None
68	Delete OSPF interface successful.	Component state	None
69	Retrieving OSPF configuration successful.	Component state	None
70	Retrieving OSPF interface information successful.	Component state	None

CDR_COLLECTOR (23)

Table 28: CDR_COLLECTOR (23) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	CDR Manager failed to open accounting file for writing. The CDR Manager will halt.	Possible impact to user accounting and billing. Situation should repair following component restart.	If problem persists Contact Technical Support for investigation.
2	Memory allocation failure - unable to generate accounting record. CDR Manager will halt.	Possible impact to user accounting and billing. Situation should repair following component restart. However condition may be result of larger issue with memory resource utilization.	If problem persists Contact Technical Support for investigation.
3	File storage limit has been reached for the accounting files. The oldest file(s) will be deleted to free up room for the new accounting files.	CDRs will be truncated to create room for new records.	Customer should retrieve CDRs more frequently and clear old files.
8	CDR critical:%s.	n/a	n/a
Major			
9	Internal messaging error:%d. Accounting information for one client session will be incomplete.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
11	Can not create new CDR record for session%d. Accounting record for one client session will be unavailable.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.

Table 28: CDR_COLLECTOR (23) logs and events (Continued)

Log ID	Log Message	Comment	Action
12	Internal messaging error:%d. Error will be ignored and message re-tried.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
13	Internal messaging error:%d. Error will be ignored and message re-tried.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
14	CDR Manager failed when attempting to write client record to accounting file. Accounting record for this client session will be unavailable.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
15	Internal messaging error - more accounting records were received than expected. Known sessions will be processed; unknown information will be dropped.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
32	CDR major:%s.	n/a	n/a
Minor			
33	Unable to add binary property to internal message payload [%d]. Error will be ignored and processing continued.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
34	Unable to add integer property to internal message payload [%d]. Error will be ignored and processing continued.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
35	Unable to add string property to internal message payload [%d]. Error will be ignored and processing continued.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
36	Unable to add array property to internal message payload [%d]. Error will be ignored and processing continued.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
37	Unable to read binary property from internal message payload [%d]. Error will be ignored and processing continued.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
38	Unable to read integer property from internal message payload [%d]. Error will be ignored and processing continued.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
39	Unable to read string property from internal message payload [%d]. Error will be ignored and processing continued.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
40	Unable to read array property from internal message payload [%d]. Error will be ignored and processing continued.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.

Table 28: CDR_COLLECTOR (23) logs and events (Continued)

Log ID	Log Message	Comment	Action
41	Client statistics message failed to be logged to accounting record. Record may be incomplete for client session.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
42	Client authentication message failed to be logged to accounting record. Record will be incomplete for client session.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
43	Client status change message failed to be logged to accounting record. Record will be incomplete for client session.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
44	Client de-registration message failed to be logged to accounting record. Record will be incomplete for client session.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
45	CDR record to update [%d] does not exist. Error will be ignored and processing continued.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
46	Wrong length of binary data received [%d] [len=%d]. Error will be ignored and processing continued.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
47	Can not free memory used for storing client accounting record. A memory leak is occurring. CDR Manager will continue processing.	Internal operation error. Specific CDR record may not be consistent. However condition may indicate more serious condition with system memory resource management.	If problem persists Contact Technical Support for investigation.
64	CDR minor:%s.	n/a	n/a
	Unable to subscribe messages.	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
	Fail to receive cdr_config_notify.	Possible issue with configuration of CDR/Accounting sub-system. Can result in lack of accounting reporting/CDR for system users. Doesn't affect users state, however, it doesn't allow owner to provide proper billing for services rendered.	Validate configuration of CDR/ Accounting settings for Radius Server and WM-AD definitions. If problem persists contact Technical Support to investigate.
	Fail to receive stats bundle notify.	Internal operation error. One update snampshot is missed. Possible impact to CDR/ Accounting state. Subsequent updates should remedy the situation.	If problem persists Contact Technical Support for investigation.
	Fail to receive authenticated userid from security manager.	Internal operation error. Specific CDR record may not be consistent. Tracking CDR is harder without username property.	If problem persists Contact Technical Support for investigation.

Table 28: CDR_COLLECTOR (23) logs and events (Continued)

Log ID	Log Message	Comment	Action
	Client MAC:%s User-ID:%s: has invalid IP address [0.0.0.0]. Failed to create CDR.	User records are not tracked until user obtains proper IP address. Verify that users are able to obtain proper addresses from WM-AD.	If problem persists Contact Technical Support for investigation.
	Fail to receive message get_params_resp:%d	Internal operation error. Specific CDR record may not be consistent.	If problem persists Contact Technical Support for investigation.
	Fail to receive message mu_deregister_notify:%d	Internal operation issue. Specific CDR may not be consistent. User termination time may not be properly adjusted.	If problem persists Contact Technical Support for investigation.
	Fail to receive message smt_shutdown_component_req: %d	System shutdown operation under admin control (enable/ disable feature, system shutdown).	If problem persists Contact Technical Support for investigation.
	Fail to receive message es_log_lvl_update_notify:%d	Internal communications issue. Unable to determine proper logging level for component.	If problem persists Contact Technical Support for investigation.
Info			
65	New CDR file has been created.	Accounting state	If problem persists Contact Technical Support for investigation.
66	Created a new CDR record with session id%d.	Accounting state	If problem persists Contact Technical Support for investigation.
67	CDR record was written to file with session id%d.	Accounting state	If problem persists Contact Technical Support for investigation.
68	CDR Manager started normally.	Accounting sub-system state	If problem persists Contact Technical Support for investigation.
69	All CDR records written to file. Shutting down normally.	Accounting sub-system state	If problem persists Contact Technical Support for investigation.
70	The old CDR directory has been removed.	Accounting sub-system state	If problem persists Contact Technical Support for investigation.
128	CDR informational:%s.	n/a	n/a

RF_DATA_COLLECTOR (36)

Table 29: RF_DATA_COLLECTOR (36) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	An error has occurred in the RF Data Collector which will cause this component to shutdown (and be restarted by the system). Details:%s.	Internal operation error. Rogue AP scan updates may be temporarily suspended. Should resume once component is automatically restarted by the system's health monitor.	If problem persists Contact Technical Support for investigation.
Major			
9	An error has occurred in the RF Data Collector. This error will be ignored and the component will attempt to continue. Details:%s.	Internal operation error. Relay of Rogue AP scan updates may be temporarily suspended.	If problem persists Contact Technical Support for investigation.
Minor			
33	An error has occurred in the RF Data Collector which will not interfere with system processing. This error will be ignored and processing continued. Details:%s.	Internal operation error. Relay of Rogue AP scan updates may be temporarily suspended.	If problem persists Contact Technical Support for investigation.
Info			
65	Received scan request with req_id of zero	Possible operational error for Summit spy feature.	If problem persists Contact Technical Support for investigation.
	Poll timeout with INS session	Possible operational error for Summit spy feature.	"Determine if outage was caused by configuration change to Summit spy feature (add/ Remove of controllers from Scan Domain). Determine if outage was caused by network path interruption. If interruption was caused by failure of INS controller, please review the log of that controller to determine appropriate action.
	Connection with INS is up	Link with INS state (Summit spy)	None
	Connection with INS is down	Possible operational error for Summit spy feature.	"Determine if outage was caused by configuration change to Summit spy feature (add/ Remove of controllers from Scan Domain). Determine if outage was caused by network path interruption. If interruption was caused by failure of INS controller, please review the log of that controller to determine appropriate action.

REMOTE_INS (58)

Table 30: REMOTE_INS (58) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	Rogue AP found by AP%s (SN%s) for scan%s (ID%d) on%s with unknown bssType%u	Scan Result indication	Take appropriate remedial action to identify and neutralize threat.
	Threat [Inactive AP with valid SSID] detected by AP%s, SN%s (%s). Details: RSSI:%u, scanned channel:%u, channel_rx:%u, bssid:%s, ssid:%s, privacy:%s, bssType:%s, beaconInterval:%dms	Scan Result indication	Take appropriate remedial action to identify and neutralize threat.
	Threat [Unknown AP with invalid SSID] detected by AP%s, SN%s (%s). Details: RSSI:%u, scanned channel:%u, channel_rx:%u, bssid:%s, ssid:%s, privacy:%s, bssType:%s, beaconInterval:%dms	Scan Result indication	Take appropriate remedial action to identify and neutralize threat.
	Threat [Known AP with valid SSID] detected by AP%s, SN%s (%s). Details: RSSI:%u, scanned channel:%u, channel_rx:%u, bssid:%s, ssid:%s, privacy:%s, bssType:%s, beaconInterval:%dms	Scan Result indication	Take appropriate remedial action to identify and neutralize threat.
	Unable to malloc memory.	Internal operation error. May indicate a larger problem with system's memory resource management.	If problem persists Contact Technical Support for investigation.
	Malloc failed	Internal operation error. May indicate a larger problem with system's memory resource management.	If problem persists Contact Technical Support for investigation.
	Unable to initialize semaphores	Internal operation error. May indicate a larger problem with system's memory resource management.	If problem persists Contact Technical Support for investigation.
	Unable to initialize signal handlers	Internal operation error. May indicate a larger problem with system's memory resource management.	If problem persists Contact Technical Support for investigation.
	Unable to initialize internal configuration data structures	Internal operation error. May indicate a larger problem with system's memory resource management.	If problem persists Contact Technical Support for investigation.

Table 30: REMOTE_INS (58) logs and events (Continued)

Log ID	Log Message	Comment	Action
	Unable to initialize global log bitmask	Internal operation error. May indicate a larger problem with system's memory resource management.	If problem persists Contact Technical Support for investigation.
Major			
9	%s		
	Threat [Known AP with invalid SSID] detected by AP%s, SN%s (%s). Details: RSSI:%u, scanned channel:%u, channel_rx:%u, bssid:%s, ssid:%s, privacy:%s, bssType:%s, beaconInterval:%dms	Scan Result indication	Take appropriate remedial action to identify and neutralize threat.
	Threat [Device in ad-hoc mode] detected by AP%s, SN%s (%s). Details: RSSI:%u, scanned channel:%u, channel_rx:%u, bssid:%s, ssid:%s, privacy:%s, bssType:%s, beaconInterval:%dms	Scan Result indication	Take appropriate remedial action to identify and neutralize threat.
	Error in analysis_threads: empty command arguments. Thread will exit	Internal operation error. Thread exist shall cause component to terminate and be automatically started by system's health monitor facility. Situation should repair itself.	If problem persists Contact Technical Support for investigation.
	Error in analysis_thread: failed to create analysis message queue. Thread will exit	Internal operation error. Thread exist shall cause component to terminate and be automatically started by system's health monitor facility. Situation should repair itself.	If problem persists Contact Technical Support for investigation.
	Error in analysis_thread: failed to connect to db message queue. Thread will exit	Internal operation error. Thread exist shall cause component to terminate and be automatically started by system's health monitor facility. Situation should repair itself.	If problem persists Contact Technical Support for investigation.
	Error in send_ins_delete_rogue_req_msg_ to_db_thread: failed to connect to db message queue. Cannot cleanup database.	Internal operation error. Problem may prevent Rogue AP (Summit spy) detection from taking place. Component may need to be restarted.	If problem persists Contact Technical Support for investigation.
	Error in setting up RFDC connection: cannot initialize pthread attributes. Connection cannot be setup.	Internal operation error. Problem may prevent Rogue AP (Summit spy) detection from taking place. Component may need to be restarted.	If problem persists Contact Technical Support for investigation.
	Error in setting up RFDC connection: cannot set detached pthread attributes. Connection cannot be setup.	Internal operation error. Problem may prevent Rogue AP (Summit spy) detection from taking place. Component may need to be restarted.	If problem persists Contact Technical Support for investigation.

Table 30: REMOTE_INS (58) logs and events (Continued)

Log ID	Log Message	Comment	Action
	Error in setting up RFDC connection: Cannot save client session information into memory. Connection cannot be setup.	Internal operation error. Problem may prevent Rogue AP (Summit spy) detection from taking place. Component may need to be restarted.	If problem persists Contact Technical Support for investigation.
	Unable to setup RFDC connection	Internal operation error. Problem may prevent Rogue AP (Summit spy) detection from taking place. Component may need to be restarted.	If problem persists Contact Technical Support for investigation.
	Error in deleting RFDC connection: Cannot delete client information. Will try to tear down connection.	Internal operation error. Failure to delete peer from monitor list should not affect state of feature. Rogue AP detection should be able to proceed.	If problem persists Contact Technical Support for investigation.
	Unable to signal RFDC connection to shutdown.	Internal operation error. Failure to delete peer from monitor list should not affect state of feature. Rogue AP detection should be able to proceed.	If problem persists Contact Technical Support for investigation.
	Error in db_thread: empty command arguments. Thread will exit	Internal operation error. Failure to delete peer from monitor list should not affect state of feature. Rogue AP detection should be able to proceed.	If problem persists Contact Technical Support for investigation.
	Error in db_thread: cannot connect to Database. Thread will exit	Internal operation error. Failure to delete peer from monitor list should not affect state of feature. Rogue AP detection should be able to proceed.	If problem persists Contact Technical Support for investigation.
	Error in db_thread: Failed to create db message queue. Thread will exit	Internal operation error. Failure to delete peer from monitor list should not affect state of feature. Rogue AP detection should be able to proceed.	If problem persists Contact Technical Support for investigation.
	Malloc failed	Internal operation error. Failure to delete peer from monitor list should not affect state of feature. Rogue AP detection should be able to proceed.	If problem persists Contact Technical Support for investigation.
	Error: Failed to connect to analysis message queue. Thread will exit	Internal operation error. Failure to delete peer from monitor list should not affect state of feature. Rogue AP detection should be able to proceed.	If problem persists Contact Technical Support for investigation.
Minor			
33	In run_analysis_against_specific_list: cleanup_memory_for_data for AP failed.	Internal operation issue. May result in problems with memory management for the system.	If problem persists Contact Technical Support for investigation.
	In run_analysis_against_specific_list: cleanup_memory_for_data for THIRD_PAP failed.	Internal operation issue. May result in problems with memory management for the system.	If problem persists Contact Technical Support for investigation.

Table 30: REMOTE_INS (58) logs and events (Continued)

Log ID	Log Message	Comment	Action
	In run_analysis_against_specific_list: cleanup_memory_for_data for FRIENDLY_AP failed.	Internal operation issue. May result in problems with memory management for the system.	If problem persists Contact Technical Support for investigation.
	Unable to cleanup memory for AP information. Memory leak may occur	Internal operation issue. May result in problems with memory management for the system.	If problem persists Contact Technical Support for investigation.
	Unable to cleanup memory for 3rd party information. Memory leak may occur	Internal operation issue. May result in problems with memory management for the system.	If problem persists Contact Technical Support for investigation.
	Unable to cleanup memory for friendly AP party information. Memory leak may occur	Internal operation issue. May result in problems with memory management for the system.	If problem persists Contact Technical Support for investigation.
	Unable to cleanup memory for RF Data Collector connection information. Memory leak may occur	Internal operation issue. May result in problems with memory management for the system.	If problem persists Contact Technical Support for investigation.
	Unable to cleanup memory for Scan group information. Memory leak may occur	Internal operation issue. May result in problems with memory management for the system.	If problem persists Contact Technical Support for investigation.
	Cannot change scan parameters or list of APs when scan is in progress. Scan update failed.	Operational error. Operator can't change parameters for a running scan. Scan must first be stopped and then modified.	None
	Unable to determine time when scan results received from RFDC. Cannot process results and will have to drop them.	Internal operational issue. May result in failure to identify possible threat.	If problem persists Contact Technical Support for investigation.
Info			
65	Sending Scan Request with req_id zero	Summit spy feature state	None
	Received RFDC Shutdown notify message for RFDC session with ip addr%s	Summit spy feature state	None
	Received RFDC Shutdown notify message for RFDC session (id =%d)	Summit spy feature state. Explicit shutdown indicates result of administrative action (Disable feature/Role, system shutdown)	None
	Received request from CM to delete RFDC session (id =%d). Cannot process this request.	Internal operating issue. Possible configuration mismatch. Deletion however should have no impact on running detection scans.	If problem persists Contact Technical Support for investigation.
	Received request from CM to delete RFDC session with ip addr%s	Summit spy feature state	None
	Connection with RFDC session with ip addr%s is up	Summit spy feature state	None
	Connection with RFDC session (id =%d) is up	Summit spy feature state	None

Table 30: REMOTE_INS (58) logs and events (Continued)

Log ID	Log Message	Comment	Action
	Connection with AC for RFDC session with ip addr%s is down	Possible Feature Impact. Scanning peer may not be available to report information.	Determine if outage was caused by configuration change to Summit spy feature (add/ Remove of controllers from Scan Domain). Determine if outage was caused by network path interruption. If interruption was caused by failure of INS controller, please review.
	Connection with AC for RFDC session (id =%d) is down	Possible Feature Impact. Scanning peer may not be available to report information.	Determine if outage was caused by configuration change to Summit spy feature (add/ Remove of controllers from Scan Domain). Determine if outage was caused by network path interruption. If interruption was caused by failure of INS controller, please review.
	Connection with AC for RFDC session with ip addr%s is up	Summit spy feature state	None
	Connection with AC for RFDC session (id =%d) is up	Summit spy feature state	None
	Connection with RFDC session with ip addr%s is lost due to poll timeout.	Possible Feature Impact. Scanning peer may not be available to report information.	Determine if outage was caused by configuration change to Summit spy feature (add/ Remove of controllers from Scan Domain). Determine if outage was caused by network path interruption. If interruption was caused by failure of INS controller, please review.
	Connection with RFDC session (id =%d) lost due to poll timeout.	Possible Feature Impact. Scanning peer may not be available to report information.	Determine if outage was caused by configuration change to Summit spy feature (add/ Remove of controllers from Scan Domain). Determine if outage was caused by network path interruption. If interruption was caused by failure of INS controller, please review.

LLC_HANDLER (62)

Table 31: LLC_HANDLER (62) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	Malloc failed	Internal operation error. May indicate a larger problem with system's memory resource management.	If problem persists Contact Technical Support for investigation.
	Unable to initialize semaphores	Internal operation error. May indicate a larger problem with system's memory resource management.	If problem persists Contact Technical Support for investigation.
	Unable to initialize signal handlers	Internal operation error. May indicate a larger problem with system's memory resource management.	If problem persists Contact Technical Support for investigation.
	Unable to initialize global log bitmask	Internal operation error. May indicate a larger problem with system's memory resource management.	If problem persists Contact Technical Support for investigation.
	Unable to initialize internal configuration data structures	Internal operation error. May indicate a larger problem with system's memory resource management.	If problem persists Contact Technical Support for investigation.
Major			
9	Error in main: Cannot determine langley connection options. Exit	Internal communications issue. Possible misconfiguration of internal settings. Exiting should cause component to be restarted by system's health monitoring framework.	If problem persists Contact Technical Support for investigation.
	Error in main: Cannot determine langley connection subscriptions. Exit	Internal communications issue. Possible misconfiguration of internal settings. Exiting should cause component to be restarted by system's health monitoring framework.	If problem persists Contact Technical Support for investigation.
	Malloc failed	Internal operation error. May indicate a larger problem with system's memory resource management.	If problem persists Contact Technical Support for investigation.
	Error in llc_packet_thread: empty command arguments. Thread will exit	Internal operation error. Thread exist shall cause component to terminate and be automatically started by system's health monitor facility. Situation should repair itself.	If problem persists Contact Technical Support for investigation.
	Error in llc_packet_thread: Cannot determine langley connection options. Thread will exit	Internal operation error. Thread exist shall cause component to terminate and be automatically started by system's health monitor facility. Situation should repair itself.	If problem persists Contact Technical Support for investigation.

Table 31: LLC_HANDLER (62) logs and events (Continued)

Log ID	Log Message	Comment	Action
	Error in llc_packet_thread: Cannot determine langley connection subscriptions. Thread will exit	Internal operation error. Thread exist shall cause component to terminate and be automatically started by system's health monitor facility. Situation should repair itself.	If problem persists Contact Technical Support for investigation.
	Error in initialize_tlv_dictionary: empty command arguments: cannot get tlv dictionary path	Internal operation error. Thread exist shall cause component to terminate and be automatically started by system's health monitor facility. Situation should repair itself.	If problem persists Contact Technical Support for investigation.
Minor			
33	Unable to cleanup 3PAP information. Memory leak may occur	Internal operation issue. May result in problems with memory management for the system.	If problem persists Contact Technical Support for investigation.
	In determine_whether_mac_address_is_a_3pap: cleanup_memory_for_data for THIRD_PAP failed	Internal operation issue. May result in problems with memory management for the system.	If problem persists Contact Technical Support for investigation.
	In determine_whether_mac_address_is_a_bp: cleanup_memory_for_data for BP failed.	Internal operation issue. May result in problems with memory management for the system.	If problem persists Contact Technical Support for investigation.

RADIUS_ACCOUNTING (64)

Table 32: RADIUS_ACCOUNTING (64) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	No Response from all RADIUS accounting server(s):%s.	Possible issue with configuration of CDR/Accounting sub-system. Can result in lack of accounting reporting/CDR for system users. Doesn't affect users state, however, it doesn't allow owner to provide proper billing for services rendered.	Validate configuration of CDR/ Accounting settings for Radius Server and WM-AD definitions. If problem persists contact Technical Support to investigate.

Table 32: RADIUS_ACCOUNTING (64) logs and events (Continued)

Log ID	Log Message	Comment	Action
Major			
9	No Response from one RADIUS accounting server:%s.	Possible issue with configuration of CDR/Accounting sub-system. Can result in lack of accounting reporting/CDR for system users. Doesn't affect users state, however, it doesn't allow owner to provide proper billing for services rendered. If backup/ alternate servers were defined system will attempt to connect to them.	Validate configuration of CDR/ Accounting settings for Radius Server and WM-AD definitions. If problem persists contact Technical Support to investigate.

RU_SESMGR_ID (65)

Table 33: RU_SESMGR_ID (65) logs and events

Log ID	Log Message	Comment	Action
Major			
9	Loss of active mobility tunnel with Peer%s detected. Please verify reachability. System will reattempt connection.	Possible Feature Impact. Some possible user impact as tunnel change purges sessions associated with peer. Users if connected will need to re-authenticate and renegotiate topology profile.	Determine if outage was caused by configuration change to Mobility feature (add/Remove of controllers from Mobility Domain). Determine if outage was caused by network path interruption. If interruption was caused by failure of Mobility controller, please review log file to determine appropriate root cause and corresponding action.
Minor			
33	Successfully established mobility tunnel with peer%s.	Inter-AC Mobility State	None
34	Mobility tunnel with Peer%s reset due to membership credentials change.	Inter-AC Mobility State. Administrator changed mobility domain membership list.	None
35	Mobility tunnels with Peers reset due to membership credentials change on current controller.	Inter-AC Mobility State. Administrator changed mobility domain membership list.	None
36	Mobility tunnel establishment failed with Peer%s. Please verify peer's reachability.	Possible Feature Impact. Some possible user impact as tunnel change purges sessions associated with peer. Users if connected will need to re-authenticate and renegotiate topology profile.	Determine if outage was caused by configuration change to Mobility feature (add/Remove of controllers from Mobility Domain). Determine if outage was caused by network path interruption. If interruption was caused by failure of Mobility controller, please review log file to determine appropriate root cause and corresponding action

Table 33: RU_SESMGR_ID (65) logs and events (Continued)

Log ID	Log Message	Comment	Action
37	Mobility manager startup.	Component state	None
38	RU Session Manager startup.	Component state	None
Info			
65	Access point registration and authentication succeeded. (%S.)	Access Controller registration state	None
66	Access point registration and/or authentication failed. (%S.)	Access Controller registration failed. AP unsuccessful in establishing credential exchange with controller. AP will retry.	If problem persists Contact Technical Support for investigation.
67	Access point session poll disconnect AP session timed out. (%S.)	AP disconnected from active controller. May no longer be available for RF coverage.	Determine if outage was caused by configuration change (Delete/ Pending/Release). Determine if outage was caused by network path interruption. If interruption was caused by functional issue with AP or controller please contact Technical Support to investigate.
68	Access controller tunnel registration failed (%s).	Possible Feature Impact. Some possible user impact as tunnel change purges sessions associated with peer. Users if connected will need to re-authenticate and renegotiate topology profile.	Determine if outage was caused by configuration change to Mobility feature (add/Remove of controllers from Mobility Domain). Determine if outage was caused by network path interruption. If interruption was caused by failure of Mobility controller, please review log file to determine appropriate root cause and corresponding action.
69	Access point software version validation failed. (%s)	AP was determined to not be running an adequate firmware version for operation with controller. May be result of administration specification of firmware upgrade request.	Validate version incompatibility of AP. Verify that correct upgrade image is available. Upgrade will take place automatically.
70	%s transmission failed.	Interprocess communication failure between AP and controller.	If problem persists Contact Technical Support for investigation.

MU_SESMGR_ID (66)

Table 34: MU_SESMGR_ID (66) logs and events

Log ID	Log Message	Comment	Action
Minor			
33	Maximum number of home sessions has been reached. No more home users will be permitted.	Reached maximum user capacity for system. Need to deploy additional controllers to take on excessive capacity.	Contact Sales support to discuss expanding deployment.

Table 34: MU_SESMGR_ID (66) logs and events (Continued)

Log ID	Log Message	Comment	Action
34	Maximum number of visiting sessions has been reached. No more visiting users will be permitted.	Reached maximum user capacity for system. Need to deploy additional controllers to take on excessive capacity.	Contact Sales support to discuss expanding deployment.
Info			
65	Client session registration succeeded (%s)	New user joined coverage domain.	None
66	Client session registration failed (%s) Idle timeout.	No activity has been seen from user session by threshold time. Session terminated under assumption that user roamed away from coverage domain.	None
67	Client session de-registration succeeded (%s) Reason is: Idle timeout.	No activity has been seen from user session by threshold time. Session terminated under assumption that user roamed away from coverage domain.	None
69	Client session state changed (%s)	Authentication, administrative or remote interface has changed the state of a particular user.	None
71	Client session de-registration succeeded (%s) Reason is: Idle timeout.	No activity has been seen from user session by threshold time. Session terminated under assumption that user roamed away from coverage domain.	None
72	Client session de-registration succeeded (%s) Reason is: RF Disconnected.	User requested disconnection from mobility domain (Captive Portal).	None
73	Client session de-registration succeeded (%s) Reason is: Administrator request from GUI.	Administration request to user de-registration.	None
74	Client session de-registration succeeded (%s) Reason is: Request from Other BM.	Administration/Policy request to user de-registration.	None
75	Client session de-registration succeeded (%s) Reason is: Resync cleanup.	Policy request to user de-registration.	None
76	Client session de-registration succeeded (%s) Reason is: Session roam away.	Policy/Mobility request to user de-registration.	None
77	Client session de-registration succeeded (%s) Reason is: Life time session time out.	Policy request to user de-registration.	None
78	Client session de-registration succeeded (%s) Reason is: Tunnel Disconnect.	Policy/Mobility request to user de-registration.	None
79	Client session de-registration succeeded (%s) Reason is: User request.	User requested disconnection from mobility domain (Captive Portal).	None
80	Client session de-registration succeeded (%s) Reason is: WADMGR request.	Policy/Mobility request to user de-registration.	None

Table 34: MU_SESMGR_ID (66) logs and events (Continued)

Log ID	Log Message	Comment	Action
83	Client session de-registration succeeded (%s) Reason is: User changing subnet.	Policy request to user de-registration.	None

FILTER_MGR_ID (67)

Table 35: FILTER_MGR_ID (67) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	Connection to messaging bus failed - reason [%d]. Filter Manager shutdown!!!	Internal operation error. Connection will be re-attempted.	If problem persists Contact Technical Support for investigation.
Major			
9	Unknown filter ID [%d] to be sent to FE.	Possible configuration issue. Unknown configuration element may cause operational issues.	If problem persists Contact Technical Support for investigation.
10	Number of rules per filter ID [%d] exceeds the limit.	Limits enforcement. Possible that some of the intended filter rules for a definition have not been persisted.	Revisit rule definition to determine effectiveness of existing definitions and identify set of rules to possible delete to create additional space
11	Total number of rules exceeds the limit [%d].	Limits enforcement. Possible that some of the intended filter rules for a definition have not been persisted.	Revisit rule definition to determine effectiveness of existing definitions and identify set of rules to possible delete to create additional space
12	No rules defined for this filter ID [%d].	Internal Error Condition. Filers are defined by default with at least 1 rule (Deny All). This condition should never occur.	If problem persists Contact Technical Support for investigation.
13	Filter rules response returned NACK. Error code [%d].	Internal operation failure. Failed to obtain a set of filter rules from the systems provisioning system. Component will retry.	If problem persists Contact Technical Support for investigation.
14	FE is not responding - error [%d].	Failed to communicate with FE during provisioning or stats collection information. Filtering system will reset.	If problem persists Contact Technical Support for investigation.
15	Configuring wrong filter ID [%d].	Internal operation error in processing a Filter group. Possible misconfiguration problem. Filtering sub-system will retry.	If problem persists Contact Technical Support for investigation.
16	Property array is NULL for the received message [%d].	Internal operation failure.FIter sub-system will retry.	If problem persists Contact Technical Support for investigation.

Table 35: FILTER_MGR_ID (67) logs and events (Continued)

Log ID	Log Message	Comment	Action
17	Failed to send message [%d].	Internal operation failure. Filter sub-system will retry	If problem persists Contact Technical Support for investigation.
18	Filter params is NULL for message [%d].	Internal operation failure. Filter sub-system will retry	If problem persists Contact Technical Support for investigation.
19	Failed to initialize list for message [%d].	Internal operation failure. Filter sub-system will retry	If problem persists Contact Technical Support for investigation.
20	Timer initialization failed - error [%d].	Internal operation failure. Filter requests may not follow proper timeout values. Component may require reset.	If problem persists Contact Technical Support for investigation.
21	Filter purge response returned NACK - error [%d].	Internal operation error. Failure to reset FE filter table. FE may be operating with incorrect filter set.	If problem persists Contact Technical Support for investigation.
22	Unknown rule index [%d].	Internal operation failure. Filter sub-system will retry	If problem persists Contact Technical Support for investigation.
23	Filter add response returned NACK - error [%d].	Internal operation failure. Filter sub-system will retry	If problem persists Contact Technical Support for investigation.
24	Filter delete response returned NACK - error [%d].	Internal operation failure. Filter sub-system will retry	If problem persists Contact Technical Support for investigation.
25	Filter stats response returned NACK - error [%d].	Internal operation failure. Filter sub-system will retry	If problem persists Contact Technical Support for investigation.
26	No FE mode was set [%d].	Failed to resolve type of FE on system. Possible impact to filtering subsystem behaviour. Filters may not be properly installed in FE	If problem persists Contact Technical Support for investigation.
27	Unknown filter ID [%d] in the update response.	Internal operation failure. Filter sub-system will retry	If problem persists Contact Technical Support for investigation.
28	Unknown filter ID [%d] in the update notify.	Internal operation failure. Filter sub-system will retry	If problem persists Contact Technical Support for investigation.
29	Unknown filter ID [%d] in the rules response.	Internal operation failure. Filter sub-system will retry	If problem persists Contact Technical Support for investigation.
30	Filter ID mismatch [%d] in the FE filter add operation.	Internal operation failure. Filter sub-system will retry	If problem persists Contact Technical Support for investigation.
Minor			
33	Failed to receive message - reason [%d].	Internal operation failure. Filter sub-system will retry	If problem persists Contact Technical Support for investigation.

Table 35: FILTER_MGR_ID (67) logs and events (Continued)

Log ID	Log Message	Comment	Action
34	Failed to process message [%d].	Internal operation failure. Filter sub-system will retry	If problem persists Contact Technical Support for investigation.
35	Unknown message type [%d].	Internal operation failure. Filter sub-system will retry	If problem persists Contact Technical Support for investigation.
36	Rules request timer has expired.	Failure to obtain response to filter provisioning operation. Filter sub-system will retry.	If problem persists Contact Technical Support for investigation.
37	FE add request timer has expired.	Failure to obtain response to filter provisioning operation to FE. Filter sub-system will retry.	If problem persists Contact Technical Support for investigation.
38	FE stats request timer has expired.	Failure to obtain response for stats request from FE. Request will be retried. No direct impact to Filtering operation.	If problem persists Contact Technical Support for investigation.
39	FE is up.	FE State is active.	None
40	FE is down.	Lost connection to FE. System operations will be severely affected. FE failure will likely cause service interruption.	If problem persists Contact Technical Support for investigation.
41	FE purge request timer has expired.	Failure to obtain response to filter provisioning operation to FE. Filter sub-system will retry.	If problem persists Contact Technical Support for investigation.
42	FE delete request timer has expired.	Failure to obtain response to filter provisioning operation to FE. Filter sub-system will retry.	If problem persists Contact Technical Support for investigation.

REDIRECTOR4 (68)

Table 36: REDIRECTOR4 (68) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	Got a bad token from secMgr for%s	Failed to obtain credential abstraction for captive portal redirection. Redirection operation will fail for that operation. Client will most likely restart.	If problem persists Contact Technical Support for investigation.
2	Client%s is in an infinite loop!	Detected possible issue with Client behaviour on redirection.	Verify that ""Non-Authenticated"" filter rules for ""WM-AD"" are properly defined to allow access to target authentication server. Filter failure may result in continuous redirection. If no configuration issue is identified Contact Technical Support to investigate.

Table 36: REDIRECTOR4 (68) logs and events (Continued)

Log ID	Log Message	Comment	Action
3	Cannot grok the MAC address for%s, ignoring request	Failed to identify session being redirected. Typically client will be retried.	If problem persists Contact Technical Support for investigation.
4	Cannot get a token from secMgr for%s (Langley communication timeout?)	Failed to obtain credential abstraction for captive portal redirection. Redirection operation will fail for that operation. Client will most likely restart.	If problem persists Contact Technical Support for investigation.
5	Cannot grok a URL for%s (Langley communication timeout?)	Failed to identify the URL to which a user session should be redirected to. Possible issue with configuration of WM-AD captive portal settings.	If problem persists Contact Technical Support for investigation.
6	Cannot grok a URL for%s (MU_S_MGR error)	Failed to identify the URL to which a user session should be redirected to. Possible issue with configuration of WM-AD captive portal settings.	If problem persists Contact Technical Support for investigation.
8	Internal error	Internal component error. Typical clients will retry operation.	If problem persists Contact Technical Support for investigation.

BEAST (75)

Table 37: BEAST (75) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	Failed to receive CIA message.	Internal communication operation.	If problem persists Contact Technical Support for investigation.
2	Unable to connect to database.	Failed to interface with provisioning system. Will affect report generation.	If problem persists Contact Technical Support for investigation.
3	Failed to initialize the input queue.	Internal operational issue. May result in failure to generate proper reports. Component may need to be reset.	If problem persists Contact Technical Support for investigation.
4	Failed to initialize the output queue.	Internal operational issue. May result in failure to generate proper reports. Component may need to be reset.	If problem persists Contact Technical Support for investigation.
Major			
9	Unable to create thread for polling MU Session Manager.	Internal operational issue. May result in failure to generate proper reports. Component may need to be reset.	If problem persists Contact Technical Support for investigation.

Table 37: BEAST (75) logs and events (Continued)

Log ID	Log Message	Comment	Action
10	Unable to create thread for polling RU Session Manager.	Internal operational issue. May result in failure to generate proper reports. Component may need to be reset.	If problem persists Contact Technical Support for investigation.
11	Unable to create thread for polling WADMGR.	Internal operational issue. May result in failure to generate proper reports. Component may need to be reset.	If problem persists Contact Technical Support for investigation.
12	Unable to create thread for polling Port Info Manager.	Internal operational issue. May result in failure to generate proper reports. Component may need to be reset.	If problem persists Contact Technical Support for investigation.
13	Unable to create thread for polling Filter Manager.	Internal operational issue. May result in failure to generate proper reports. Component may need to be reset.	If problem persists Contact Technical Support for investigation.
14	Unable to create thread for polling AP SNMP stats.	Internal operational issue. May result in failure to generate proper reports. Component may need to be reset.	If problem persists Contact Technical Support for investigation.
15	Unable to create thread for polling DAS stats.	Internal operational issue. May result in failure to generate proper reports. Component may need to be reset.	If problem persists Contact Technical Support for investigation.
16	Unable to create thread for polling RADIUS stats.	Internal operational issue. May result in failure to generate proper reports. Component may need to be reset.	If problem persists Contact Technical Support for investigation.
Minor			
33	Failed to send statistics request for AP serial number:%s.	Failure to communicate with a specific AP for the purpose of retrieving RF statistics. Request will be retried.	If problem persists Contact Technical Support for investigation.
34	Failed to process CIA message:%d.	Internal communication issue.	If problem persists Contact Technical Support for investigation.
Info			
65	Received unexpected CIA message:%d.	Internal communication issue.	If problem persists Contact Technical Support for investigation.
66	Received message [%d] whose payload is NULL.	Internal communication issue.	If problem persists Contact Technical Support for investigation.
67	Shut down Access Controller Statistician.	Statistics server is terminating. Reports will not be generated. User accounting may also be affected.	If problem persists Contact Technical Support for investigation.

ALTITUDE 350-2 (99)

Table 38: ALTITUDE 350-2(99) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	%s	ALTITUDE 350-2 Log Ids come from its own log dictionary.	n/a

FILTER_MANAGER_ID (103)

Table 39: FILTER_MANAGER_ID (103)logs and events

Log ID	Log Message	Comment	Action
Info			
65	Filter Manager configuration complete - all filter parameters have been resolved.	Notification of completion of pushing filtering policy to FE.	None

REDIR_ID (106)

Table 40: REDIR_ID (106) logs and events

Log ID	Log Message	Comment	Action
Major			
9	Redirect packet is too big, packet will be dropped (%s)	Redirector packet exceeds maximum available buffer.	None

CPDP_AGENT_ID (110)

Table 41: CPDP_AGENT_ID (110) logs and events

Log ID	Log Message	Comment	Action
Major			
9	Possible LAND DoS attack (%s).	Possible Denial of Service attack.	Investigate attach characteristics. Identify source and determine best cause of action to remedy problem.

Table 41: CPDP_AGENT_ID (110) logs and events (Continued)

Log ID	Log Message	Comment	Action
10	Possible PING-OF-DEATH DoS attack (%s).	Possible Denial of Service attack.	Investigate attach characteristics. Identify source and determine best cause of action to remedy problem.
Info			
67	CPDP thread connection reset.	Connection between FE and Management plane lost. Connection will be re-attempted and communication restored.	If problem persists Contact Technical Support for investigation.

PORT_INFO_J_MANAGER (118)

Table 42: PORT_INFO_J_MANAGER (118) logs and events

Log ID	Log Message	Comment	Action
Major			
9	Next hop device is unreachable (%s)	Next hop overwrite for WM-AD is not resolved. May be possible result of misconfiguration.	If problem persists Contact Technical Support for investigation.
Info			
65	Next hop device is reachable again (%s)	Next hop resolution state.	None

ECHELON (126)

Table 43: ECHELON (126) logs and events

Log ID	Log Message	Comment	Action
Critical			
1	FE Link is down.	Link to the FE is lost. System will reboot to reset full system.	If problem persists Contact Technical Support for investigation.
Major			
9	FE Link is up.	FE is ready to start receiving provisioning configuration from MP and to begin providing data services.	None

13 Reference lists of standards

RFC list

This section provides the Internet Engineering Task Force (IETF) Request for Comments (RFCs) standards supported by Summit WM series switch, access points, and WLAN switch software.

The Request for Comments is a series of notes about the Internet, submitted to the Internet Engineering Task Force (IETF) and designated by an RFC number, that may evolve into an Internet standard. The RFCs are catalogued and maintained on the IETF RFC website: www.ietf.org/rfc.html.

Table 44: List of RFCs

RFC Number	Title
RFC 791	IPv4
RFC 1812	Minimum Router Requirements
RFC 793	Transport Control Protocol (TCP)
RFC 768	User Datagram Protocol (UDP)
RFC 792	Internet Control Message Protocol (ICMP)
RFC 826	Address Resolution Protocol (ARP)
RFC 2865	Remote Access Dial In User Service (RADIUS)
RFC 2866	RADIUS Accounting
RFC 2165, 2608	Service Location Protocol (SLP)
RFC 2131	Dynamic Host Configuration Protocol (DHCP)
RFC 2328	Open Shortest Path First (OSPF v2)
RFC 1587	OSPF Not So Stubby Area (NSSA) Option
RFC1350:	The TFTP Protocol (Revision 2)
RFC 2716	EAP-TLS
RFC 1155	Structure and identification of management information for TCP/IP-based Internets.
RFC 1157	Simple Network Management Protocol (SNMP).
RFC 1212	Concise MIB definitions.
RFC 1213	Management Information Base for Network Management of TCP/IP-based Internets MIB-II.
RFC 1215	Convention for defining traps for use with the SNMP.
RFC 1901	Introduction to Community-based SNMPv2 (SNMPv2c).
RFC 2011	SNMPv2 Management Information Base for the Internet Protocol using SMIv2.
RFC 2012	SNMPv2 Management Information Base for the Transmission Control Protocol using SMIv2.
RFC 2013	SNMPv2 Management Information Base for the User Datagram Protocol using SMIv2.
RFC 2578	Structure of Management Information Version 2 (SMIv2).
RFC 2579	Textual Conventions for SMIv2. 2580 Conformance Statements for SMIv2.
RFC 2863	The Interfaces Group MIB.

Table 44: List of RFCs (Continued)

RFC Number	Title
RFC 3416	Version 2 of the Protocol Operations for the Simple Network Management Protocol (SNMP)
RFC 3417	Transport Mappings for the Simple Network Management Protocol (SNMP).
RFC 3418	Management Information Base (MIB) for the Simple Network Management Protocol (SNMP).
RFC 3576	Dynamic Authentication Extensions to RADIUS
RFC 959	File Transfer Protocol. (FTP)
RFC 2660	The Secure HyperText Transfer Protocol (HTTPS)
RFC 2030	Simple Network Time Protocol v4
RFC 1191	Path MTU Discovery
Internet Draft	Secure Shell v2 (SSHv2)
Internet Draft	EAP-TTLS
Internet Draft	EAP-PEAP
Internet Draft	CAPWAP Tunneling Protocol (CTP)

802.11 standards list

The following 802.11 standards are also supported:

Table 45: List of 802.11 standards supported

Standard	Name	
802.11	Wireless LAN MAC and PHY Specifications	
802.11a	Wireless LAN	High Speed Physical Layer in 5 GHz band
802.11b	Wireless LAN	High Speed Physical Layer in 2.4 GHz band
802.11d	802.11 Extensions to Operate in Additional Regulatory Domains	
802.11e	MAC Enhancements for Quality of Service	
802.11g	Wireless LAN	Further High Data Rate Extensions in 2.4 GHz band
802.11h	Spectrum managed 802.11a (in 5 GHz band in Europe)	
802.11i	WLAN security and provide better network access control	
802.11j	Wireless LAN (Japan)	
802.1x	Port based network access control	
802.1aa	802.1x maintenance	
802.3af	DTE Power via MDI (Power over Ethernet)	
802.3	CSMA/CD (Ethernet)	
802.3i	10Base-T	

Table 45: List of 802.11 standards supported (Continued)

Standard	Name	
802.3u	100Base-T	
802.3x	Full Duplex	
802.3z	1000Base-X (Gigabit Ethernet)	
802.1d	MAC bridges	
802.1p		
802.1q	VLANs	
802.11	MIB management information base for 802.11	

Supported Wi-Fi Alliance standards

The following WiFi Alliance standards are supported:

- Standard IEEE
  - IEEE 802.11a
  - IEEE 802.11b
  - IEEE 802.11g
- WPA
  - WPA - Enterprise
  - WPA - Personal
- WPA2
  - WPA2 - Enterprise
  - WPA2 - Personal
- EAP
  - EAP-TLS
  - EAP-TTLS/MSCHAPv2
  - PEAPv0/EAP-MSCHAPv2
  - PEAPv1/EAP-GTC
  - EAP-SIM
- Optional - Quality of Service
  - WMM

Glossary

Definitions and Resources

AAA	Authentication, Authentication, Accounting
CDR	Call Detail Record
CLI	Command Line Interface
Cell	RF coverage area provided by Summit WM Access Point or an Access Point
CTP	CAPWAP Tunneling Protocol
DRM	Dynamic Radio Management
EAP	Extensible Authentication Protocol
ESS	Extended Service Set
ESSID	Extended Service Set Identification
EU	European Union
GUI	Graphical User Interface
ICMP	Internet Control Message Protocol
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
ISP	Internet Service Provider
LAN	Local Area Network
MAC	Media Access Control
MIB	Management Information Base
MTU	Maximum Transmission Unit
MU	Mobile User
NAPT	Network Address Translation Protocol
NOC	Network Operations Center
RADIUS	Remote Authentication Dial In User Service
RF	Radio Frequency

Definitions and Resources (Continued)

ROW	Rest of World
RS	Radio Signal
SLP	Service Location Protocol
SNMP	Simple Network Management Protocol
SNR	Signal-to-Noise Ratio
SSID	Service Set Identifier
WISP	Wireless ISP
WLAN	Wireless Local Area Network
WM-AD	WM Access Domain Services

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